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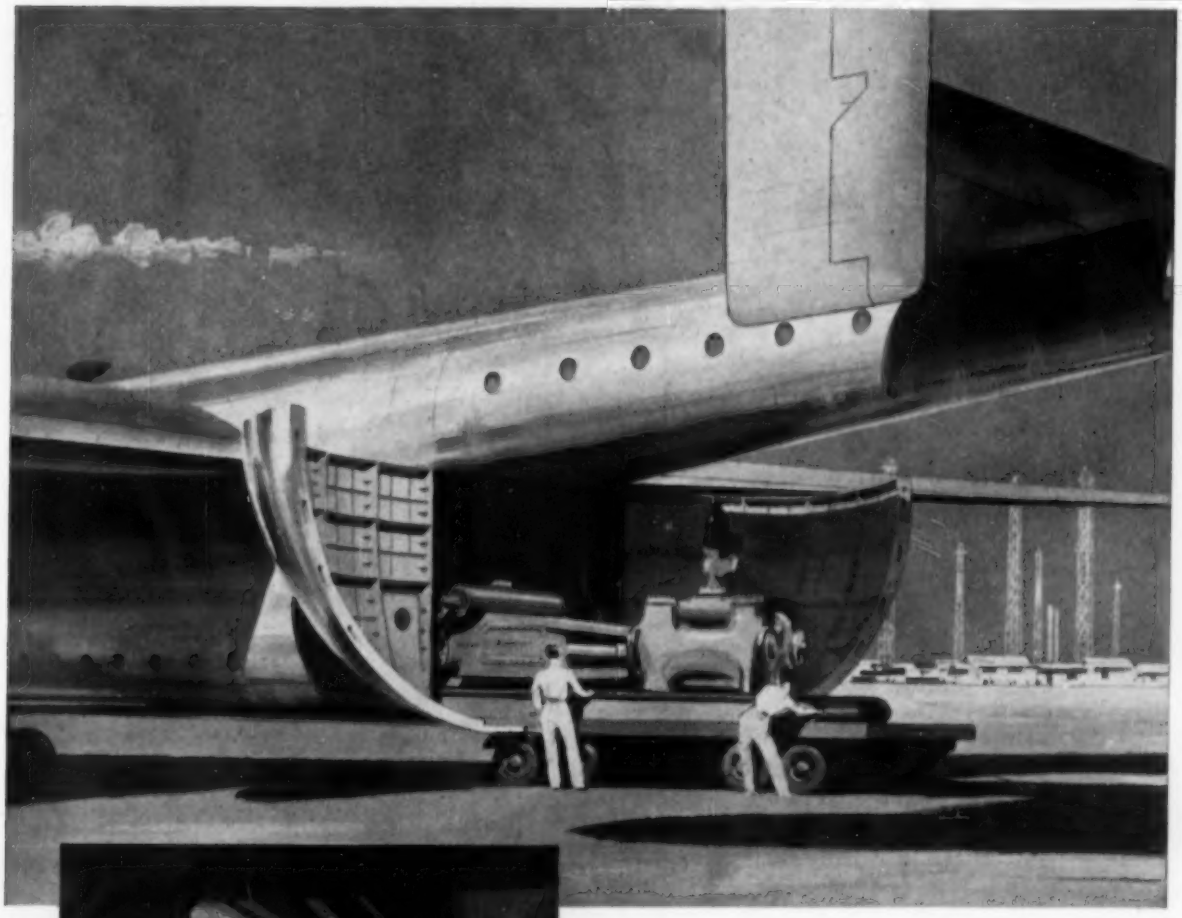

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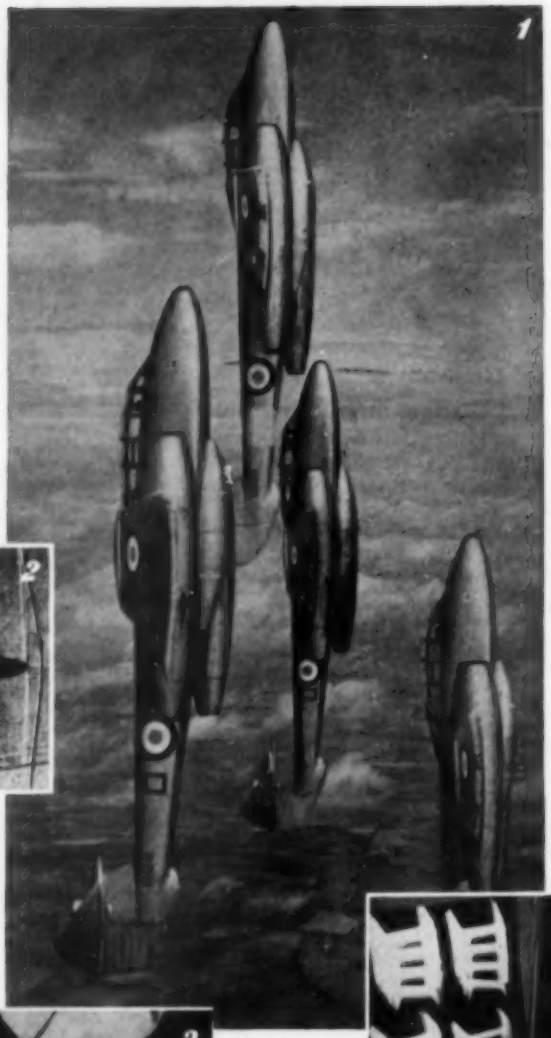

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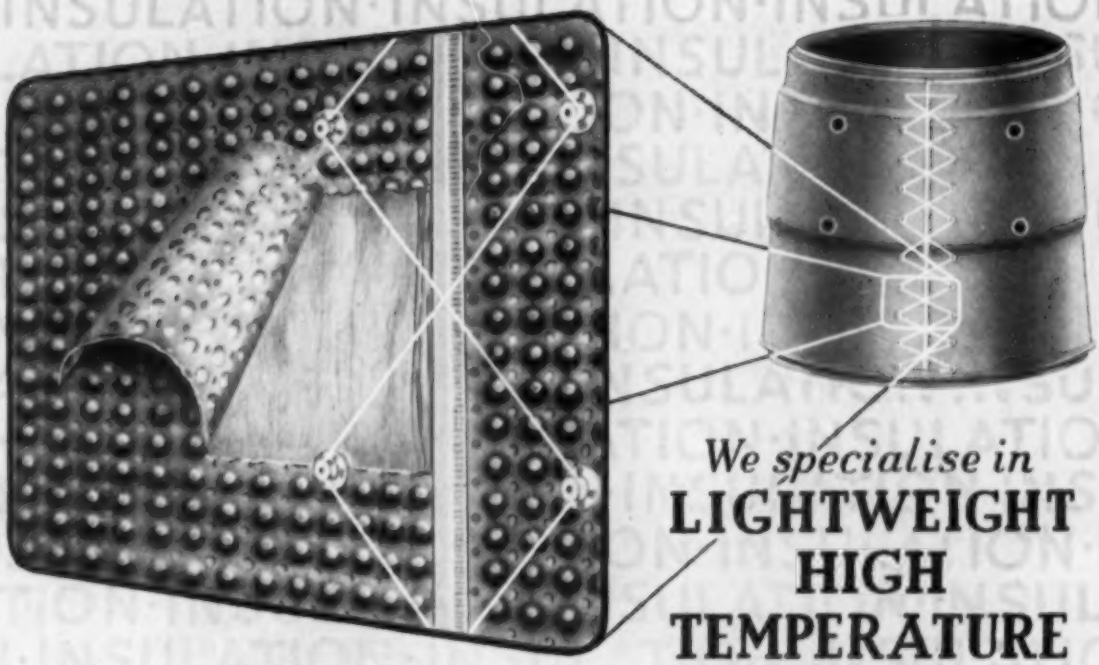

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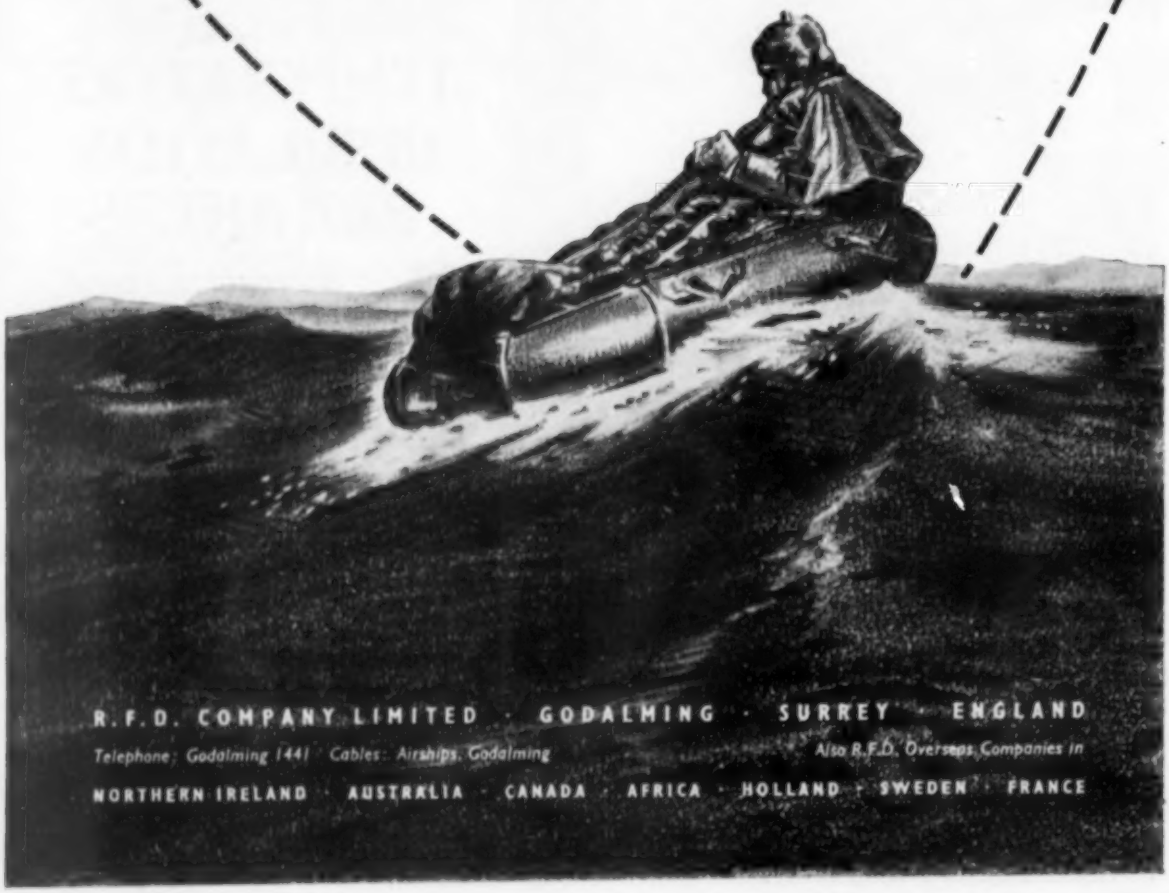

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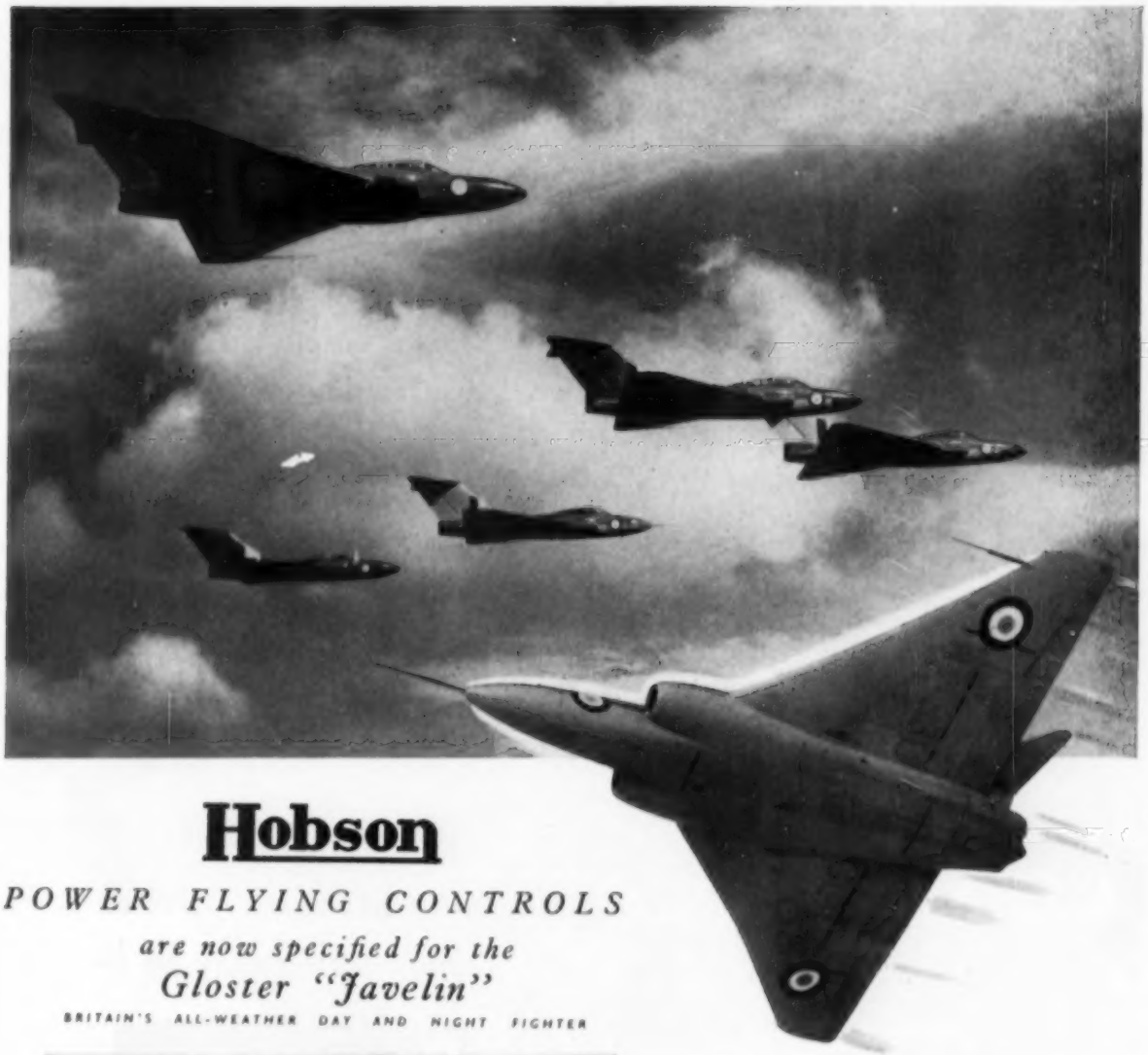

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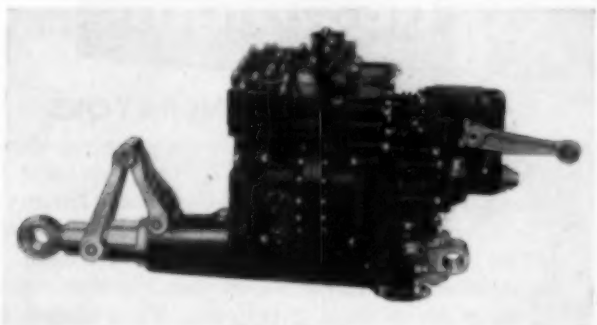

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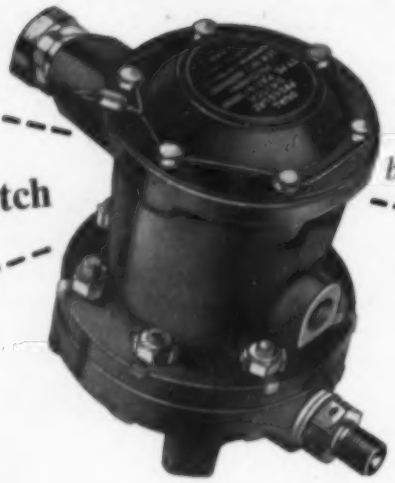

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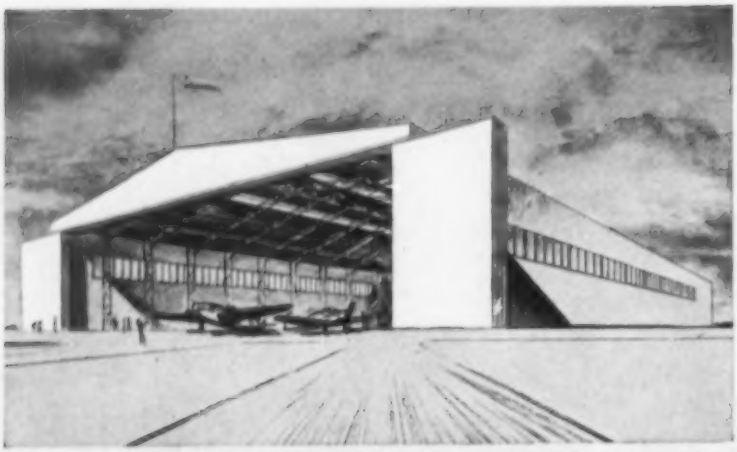

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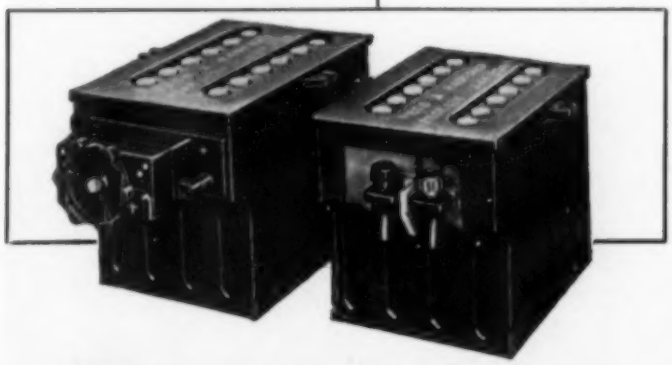

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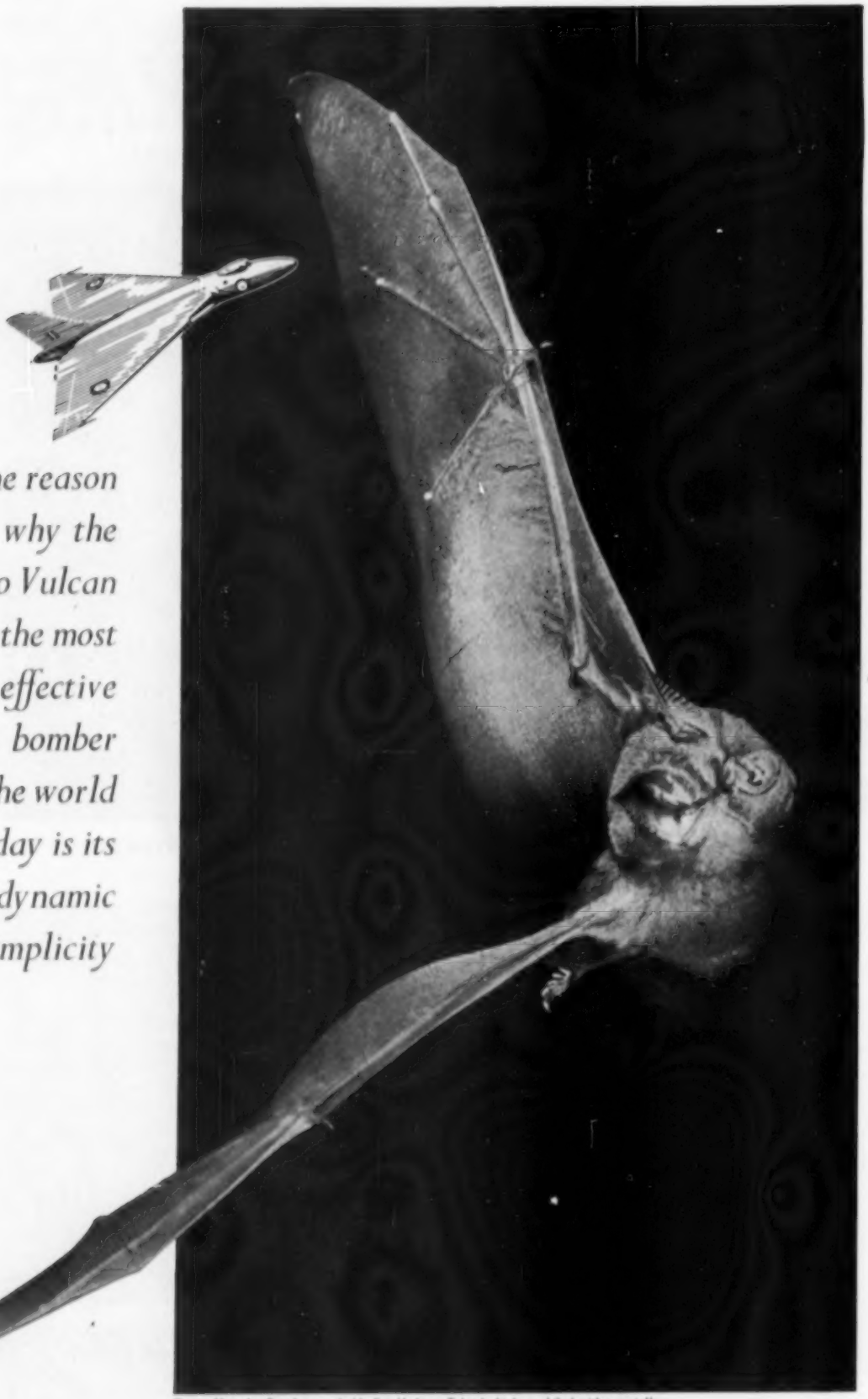

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Greater Horseshoe Bat photographed by Eric Hosking. Taken by high-speed flash with a specially constructed set giving 680 joules with two lamps at an exposure of 1/5,000th second at f/45.

FLIGHT and AIRCRAFT ENGINEER

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Founded 1909

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The Form for Farnborough

IN crew-rooms, messes, bars and board-rooms a single topic of seasonal speculation is evoked: Will it be a good Farnborough?; or, more specifically, What's new? We ourselves tip it as a greater show than ever, with novelty not only in abundance but in variety. Certainly the study of form (which, among those of our calling, is as much a duty as a hobby) encourages us to bet on two shiny new, and complementary transports—the Handley Page Herald and Scottish Aviation Twin Pioneer. A likely starter in the fastest field of all is Fairey's supersonic Delta 2; and whereas on the previous occasion Hawker Aircraft had the hybrid "Hunter variant" present (for a few split seconds), it should not be imprudent to expect a thoroughbred Hunter F.6, not to mention the side-by-side Hunter Trainer. From English Electric and Folland the P.1 and Gnat are near-certainties; from Vickers-Supermarine we are emboldened to hope for that dark horse the N.113 or something akin to it; and we should be acutely disappointed not to make some acquaintanceship, however distant, with the Gyron and Conway turbojets (perhaps, too, with some new liquid rockets). If a 1955 helicopter is in the running we should expect the Fairey ultra light; and as Avro Canada CF-100s are in the country, should not the type come in for a place, however tardily?

To shout the odds a month or so before the event would be as unpolitic as it would be undignified. But we are tempted.

Encouragement for Aerobatics

ONE of those pleasant little ceremonies for which the aviation world has so long been justly noted took place at Londonderry House last week; on this occasion it was the handing-over, for Royal Aero Club keeping, of the trophy which has been presented for the new international aerobatic competition. Lord Brabazon received the trophy from Mr. J. B. Emmott, director of the British Lockheed organization, sponsors of the competition, and incidentally remarked that it was "one of the first bits of modern art he had been able to understand." Details of the entries and regulations will be found on page 179.

Sixteen entrants, representing six countries, have indicated their intention of competing next month at Coventry, where the first annual contest is to take place. What makes this competition different and refreshing is that the spirit associated with the sport of aviation many years ago, but now largely lost, may be recaptured. It will be the skill of the pilot and not the performance of the aircraft which will count. It has been suggested that not since the earliest Schneider days has this been true of an international flying contest. Excepting engineless flight—and the national gliding contests have, of course, just taken place at Lasham in Hampshire—this is probably correct.

Among the entries received are included machines as widely different in type as the Gloster Meteor and the Auster Aiglet. The judges will certainly have a difficult though fascinating job deciding between skills demonstrated in a very large area of sky and others almost in their laps.

With the added attraction of substantial cash prizes—and there is no reason to be coy, or to pretend that financial reward is not important, particularly in view of the very considerable cost involved in competing—the 16 entries of this first year may be substantially increased in number on subsequent occasions. The British sporting flying movement badly needed a boost in the form of a competition of this kind. This remark implies no reflection upon anyone concerned with the organization of races and displays, and the difficulties of post-war private pilots are too well known to need further discussion here.

At a time when so much of flying has become a serious and involved undertaking with the accent on paper work and slide rules rather than manipulative skill, and when only the most enthusiastic pilots can find the time, money and opportunity to fly for pleasure, we welcome the initiative of the organizers and sponsors of this attractive contest and wish them and the competitors every success.

FROM ALL QUARTERS

Valiant for Australia

A VICKERS-ARMSTRONGS VALIANT B.1 left Farnborough last Sunday for Woomera, where it is to spend six months carrying out bomb ballistic trials. The aircraft—which, though it belongs to the M.o.S., is practically standard—was piloted by W/C. J. Finch, with S/L. J. R. Tanner as co-pilot. Other crew members were F/L. A. Sacks and F/L. D. Fish, navigators, and F/L. C. R. La Belle, signaller. Mr. B. A. Maries, M.o.S., flew as technical engineer.

The aircraft was to land at Habbaniya, Karachi, Negombo, Singapore, Darwin and Woomera, setting up point-to-point records for the first and penultimate legs. It left Farnborough at 1023 hr 35 sec G.M.T. and reached Baghdad 4 hr 51 min 28.8 sec later at a speed of 523.482 m.p.h. At the time of going to press it had continued to Negombo. It was to stay 20 hours at Singapore before attempting the second record to Darwin, and was due at Woomera at 6.0 a.m. on Wednesday.

Earth Satellite Project Announced

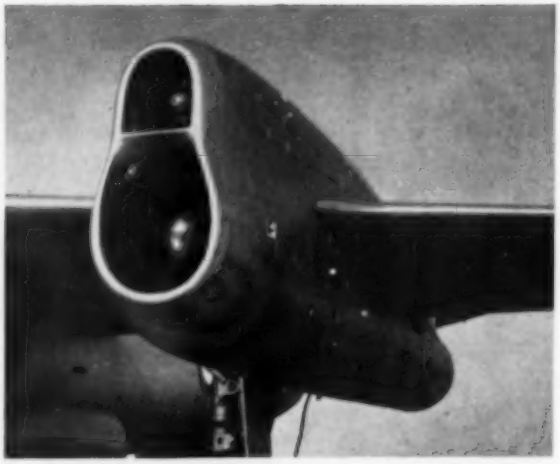
THE intention to launch one or more unmanned satellites in 1957-58 was announced in a Washington statement on Friday last. It is estimated that the vehicles, which will be of very small size—an unofficial estimate quotes a diameter of under 20 in and a weight of about 110 lb—are expected to circle the earth at an altitude of about 250 miles every 90 minutes, travelling at a speed of 18,000 m.p.h. It was emphasized that the project, which will form part of America's contribution to the International Geophysical Year, will be an entirely peaceful one and that the data obtained will be available to scientists everywhere, including Russia.

Each satellite will be launched into its orbit by a "side blast" from the final stage of a multi-stage rocket. It is thought that the vehicles will circle for something between a few days and two or three weeks; then they will gradually fall towards the earth's atmosphere, where they will become vaporized. Notwithstanding their small size, it is hoped to equip them with transmitters which will relay data on cosmic-ray and other phenomena.

Hunters In, Sabres Out

THE Ministry of Defence announced on July 29th that the Governments of the United Kingdom and the U.S.A. have completed arrangements whereby F-86E Sabres at present in service with the R.A.F. will shortly begin to be exchanged for Hawker Hunters, to be delivered from an off-shore procurement contract which the U.S. Government has placed in Britain.

Between 300 and 400 Sabres were supplied to the R.A.F. from Canada in 1952 and 1953 under a joint U.S.A./Canadian mutual aid arrangement, and additional Sabres were provided by the U.S.A. early in 1953. This very generous assistance enabled the United Kingdom to equip part of the R.A.F.'s fighter force with modern swept-wing aircraft at an earlier date than would otherwise have been possible and at a critical time in the re-equipment programme. The United Kingdom also acknowledged with gratitude (said the Ministry statement) the assistance received from the U.S.A. and Canada in the maintenance of these aircraft, and by the provision of spares. The Sabres had given most



GYRON INSTALLED in the port lower nacelle of the Short Sperrin flying test-bed (see picture opposite), which, as recently announced, flew for the first time with the powerful new de Havilland turbojet. The engine was opened up to its full flight-approved thrust.

valuable service, both in 2nd T.A.F. and Fighter Command; there were, however, substantial operational and logistic advantages in equipping the R.A.F. front line to the maximum possible extent with British aircraft that could be supported from United Kingdom stores. The United Kingdom Government accordingly accepted with gratitude the generous offer of the United States to make Hunters available in place of Sabres, which are now to be rehabilitated and transferred to the U.S. Government for reallocation under the Mutual Defence Aid Programme.

A spokesman at the U.S. Information Office in London said: "Since 1950 and up to June 30, 1955, military equipment with a value of 913.9 million dollars has been programmed by the United States as grant aid to the United Kingdom Government. A large percentage of this equipment has already been delivered. It is provided by the U.S. as a contribution to strengthen the U.K. defences in the North Atlantic Treaty Organization area. In announcing this total figure today, Maj. Gen. James W. Spry, chief of the U.S. Military Assistance Advisory Group in the U.K., also pointed out that the U.K. and U.S. have agreed that the U.S. is to provide new Hawker Hunter aircraft to the R.A.F. for older Sabre aircraft (F-86E) which had been provided for the R.A.F. by Canada and the U.S. in 1953 and 1954. General Spry noted that the Hunters which are being procured in the U.K. by the U.S. for this exchange are not included in the total figure of 913.9 million dollars. A substantial portion of the equipment being provided under the M.D.A. programme is being procured in the U.K. under the off-shore procurement programme. Such equipment is purchased by placing contracts with British manufacturers for the production of military hard goods in British plants, thereby contributing to the expansion of the U.K. economy in addition to providing equipment directly to its defence forces."

A Hawker Siddeley Group spokesman said that the Ministry of Defence statement gave effect to a U.S. off-shore procurement order of $182m for 450 Hunters, placed early last year. Of these, the majority ($140m) were destined for the R.A.F. The remaining $42m were for the manufacture of Hunters in Holland under licence. To date, export orders for the Hunter amount to £121m ($338m). Apart from the off-shore procurement contract, orders amounting to $156m had been placed independently by the Governments of Belgium, Denmark and Sweden. Belgium, like Holland, is completing her own Hunters under licence.

The British Lockheed Trophy

UNDER the regulations of the F.A.I. and the competition rules of the Royal Aero Club, the British Lockheed Trophy International Aerobatic Competition will be flown off at the Coventry Civic Aerodrome, Baginton, on Friday and Saturday, August 19th and 20th, 1955. The eliminating trials will take place between 5.30 p.m. and 8.15 p.m. on the 19th, and the final, which will involve the six competitors placed highest in the eliminating trials,

CEREMONY AT TURIN: Caselle Airport, Turin, was the setting for this ceremony of the handing over of the first Fiat-built North American F-86K fighters referred to on our "Aircraft Intelligence" page. Present were the U.S. Ambassador, Mrs. Claire Boothe Luce, generals of the U.S.A.F., Embassy officials, and Italian dignitaries, including the Archbishop of Turin.

will be flown between 4.55 p.m. and 5.50 p.m. on August 20th. The panel of judges consists of: Capt. Hubert S. Broad, Jeffrey K. Quill, Major Oliver Stewart, Geoffrey A. V. Tyson and A. Cdre. A. H. Wheeler.

The event is coincidental with the last rounds of the six National Air Races, which begin at 10 a.m. on Saturday, August 20th. The seventh race—the King's Cup—will be flown at 3.50 p.m.

The aerobatic competition is open to any individual, firm, club, Service or Government, and is being run for the first time. The trophy has been presented to the Royal Aero Club by the Lockheed Hydraulic Brake Co., Ltd., and its object is to encourage and perpetuate the art of aerobatic flying among pilots of all nations. As explained in a leading article in this issue, it is intended that the pilot, and not the aeroplane, shall be judged. The trophy will be held by the winner (who will subsequently receive a replica) for one year. Additionally, the Lockheed company will present prize money to the value of £1,200 annually, to be awarded thus: first prize £500; second, £300; third, £200; fourth, £100. A sum of £100 will also be given for the best performance in an aircraft weighing less than 1,000 kg (2,205 lb) empty, flown by a British pilot, but not in the first four places.

Each competitor will be allocated five minutes' flying time. His performance must include one slow roll, one loop and one half roll off the top of a loop. Points will be awarded as follows: scope (range of aerobatic manœuvres), 20 points; pilotage (getting the best from the aeroplane), 20 points; accuracy in execution of manœuvres, 25 points; artistry and positioning (sequence of manœuvres, etc.), 25 points; originality, 10 points.

Entries are as follows: The Argentine, Santiago Germano (Focke-Wulf Stieglitz); France, François d'Huc-Dressler (Stampe S.V.4), Léon Biancotto (Stampe S.V.4), and Alain Hisler (Sipa Minijet); Germany, Albert Falderbaum (Jungmeister); Great Britain, F. S. Symondson (D.H. Tiger Moth), Ranald L. Porteous (Auster Aiglet), F/L. H. Wood (Blackburn B.2), F/L. G. R. I. Parker (alternative pilot to H. Wood), W. H. Bailey (Miles Hawk Trainer), F. C. Fisher (D.H. Tiger Moth), R. E. Gillman (Avro Club Cadet), R. G. Wheldon (Hunting Percival Provost), S/L. M. Kilburn (D.H. Vampire Trainer), Geoffrey Worrall (Gloster Meteor); from the Netherlands, Gerben Sonderman (Fokker S.14); from Spain, José Aresu (Jungmeister).

Miles Student Announced

IT has been a fairly open secret for some months past that Miles Aircraft, Ltd., have been designing and building a completely new aircraft at Shoreham. It is now officially announced that the M.100 Student is under construction as a private venture, and that it is expected to fly early next year. The design is intended as a two-seat basic jet trainer or as a four-seat communications aircraft. Alternative powerplants are one Blackburn Turboméca Marboré 2, or two Palas 600s.

Some time ago, *Flight* was permitted to take a behind-the-scenes look at the machine, the mock-up for which was produced in the summer of 1954. It is an all-metal nosewheel design, with a roomy side-by-side cockpit in the training version, and ample space for two more seats behind for communications duties. The turbojets are mounted inboard and shoulder-high, and a N.A.C.A.-type flush intake is positioned on top of the cabin. The aircraft has a wide twin-fin tail, suggesting in its slight angularity a wartime German design.

Provisional data for the Student are as follows: span 28ft; length 27ft; height 6ft 3in; wing area 140 sq ft; wing loading 22 lb/sq ft. As a trainer the weight will be 3,100 lb, and as a communications type 3,600 lb. With the Marboré the maximum speed is expected to be in the region of 300 m.p.h., and the typical endurance for training, with 800 lb of fuel, 2.06 hours. The two-Palas version will have a slightly lower top speed of about 290 m.p.h., and, with 750 lb of fuel, a training endurance of 1.55 hours. One prototype of the aircraft is building—well advanced, in fact—and the plan is to fly it from Shoreham.

Channel History Repeated

FORTY-SIX years and three days after Blériot's epoch-making flight across the English Channel, another Frenchman has repeated the feat in a near-replica of the pioneer's machine. After a delay of three days in the expectation of suitable weather, the pilot, M. Jean Salis, took off from Calais Airport at 7 p.m. on July 28th and landed at Silver City Airways' Ferryfield some 75 minutes later. His flight, which was made at about 1,000ft with three Austers for company, covered about 45 miles—as against the 30-odd miles of Blériot's crossing, which was made from Les Barques, near Calais, to the cliffs of Dover.

M. Salis, who is 59 years of age, and has been flying for 36 years, actually received his instruction from Blériot (who died in 1936 at the age of 64). Assisted by his wife, M. Salis built the reproduction monoplane two years ago for a film—which failed to materialize—of Blériot's life.

Reports have said that the engine is a three-cylinder Anzani (Blériot employed a 25 h.p. three-cylinder "fan-type" Anzani), but we understand, and photographs confirm, that M. Salis's power unit was actually a Y-type Potez—probably the 3B, rated at a nominal 60 h.p.—manufactured in or around 1935. Modifications had been made to the lubrication system and valve gear (there are two inclined, push-rod-operated valves per cylinder), and the engine may have been de-rated so as not to place too great a load on the fragile airframe.

GYRON IN THE AIR: This and the close-up opposite are the first pictures to be released of the Sperrin with the test installation. Later a second Gyron will be fitted, in the lower starboard nacelle.

M. Salis was warmly welcomed at Ferryfield, a three-minute halt being made in the intensive car-ferry operations while he put down on the runway. Arrangements were later made for his machine to be shipped back to France in the hold of one of Silver City's Bristol Freighters.

Meanwhile, Mr. de la Bruyère, a Canadian, was awaiting anxiously at Antwerp Docks for *his* Blériot replica. Built in Edmonton, Alberta, and shipped across the Atlantic, it was delayed by the British dock strike. On Sunday he managed to achieve the flight; he took off from Calais, turned above Dover, and flew back to his starting point.

New British Engines

REFERENCE is now permissible to the Napier Gazelle NG.1, a free-turbine unit for helicopter propulsion delivering 1,260 s.h.p. There is, too, a new version of the Napier Oryx, designated NOr.10, rated at 1,250 gas horse-power. A rating of 3,000 lb thrust is given for the Scarab solid-fuel rocket developed by the Royal Aircraft Establishment.

Missile Range in Hebrides

THE Minister of Defence, Mr. Selwyn Lloyd, has announced that the Government has decided to provide a special range devoted primarily to training with guided weapons in the Hebrides—the only area in the United Kingdom suitable for the purpose. The range-head will be on the island of South Uist, and there will be facilities on neighbouring islands for flying piloted and target aircraft.

The Minister added that all firings would be made out to sea under clear-range procedures, and there should be no serious interference with fishing or shipping. Though there would be "some encroachment" on crofting land, every effort would be made to limit the loss as much as possible, and the Government would be agreeable that any question of compensation to crofters should be referred to the Scottish Land Court.

The Minister's statement added that existing ranges suitable for guided weapon firing were used primarily for development work and had insufficient capacity to meet the requirements of the Services for training in the operational use of such weapons.

Sir Arnold Hall Joins H.S. Group

THE present Director of the Royal Aircraft Establishment, Farnborough, Sir Arnold Hall, F.R.S., M.A., F.R.Ae.S., is to join the Board of the Hawker Siddeley Group as technical director, with effect from November 1st. Announcing the appointment, Sir Frank Spriggs, K.B.E., managing director of the Group, said: "We are indeed very happy that Sir Arnold Hall is joining our Board. He is justly regarded as one of the world's leading aeronautical scientists. He brings to us a wealth of

Sir Arnold Hall (right) with Sir Frank Spriggs.

FROM ALL QUARTERS . . .

aviation experience and will be an invaluable addition to the technical and scientific strength of the Hawker Siddeley Group."

Commenting on his new appointment, Sir Arnold said: "The production of the member-companies of the Hawker Siddeley Group is, and throughout aviation history always has been, a great contribution to the strength of British aviation. Although I am sorry to leave R.A.E., I am very pleased to become associated with the fine scientific and technical team which has made such products possible."

Sir Arnold, at 36 years of age, became Director of the R.A.E. in July 1951. He first joined the Establishment as a scientific officer in 1938, and during the war was engaged on wind tunnel work and on the development of bomb-sights and gun-sights. In 1945, when a principal scientific officer, he left Farnborough and went to the University of London as Zaharoff Professor of Aviation and head of the Department of Aeronautics at the Imperial College of Science and Technology. Since his return to Farnborough four years ago, much of his work has been on guided missiles, but he came prominently into the public eye as a result of his direction of Farnborough's research into the Comet disasters. Born in Liverpool in 1915, he was educated at Alsop High School, Liverpool, and Clare College, Cambridge.

The New Director, R.A.E.

THE Minister of Supply, Mr. Reginald Maudling, has appointed Mr. G. W. H. Gardner, C.B., C.B.E., the present Director-General of Technical Development (Air), Ministry of Supply, to succeed Sir Arnold Hall as Director of the Royal Aircraft Establishment, with effect from November 1st next.

Mr. G. W. H. Gardner.

Mr. Gardner was born in 1903 and educated at Campbell College and Queen's University, Belfast. From 1919-1925 he was with Harland and Woolf, Ltd., and joined the Instrument and Photographic Department of the Royal Aircraft Establishment in 1926, becoming head of that Department in 1942. In the meantime he had served at the Air Ministry and Ministry of Aircraft Production. Mr. Gardner remained as head of the Instrument and Photographic Department, R.A.E., from 1943 to 1945, when he became head of the Guided Missile Department. From 1947 to 1953 he was Principal Director of Guided Weapons at the Ministry of Supply. Since that time he has been Director-General of Technical Development (Air).

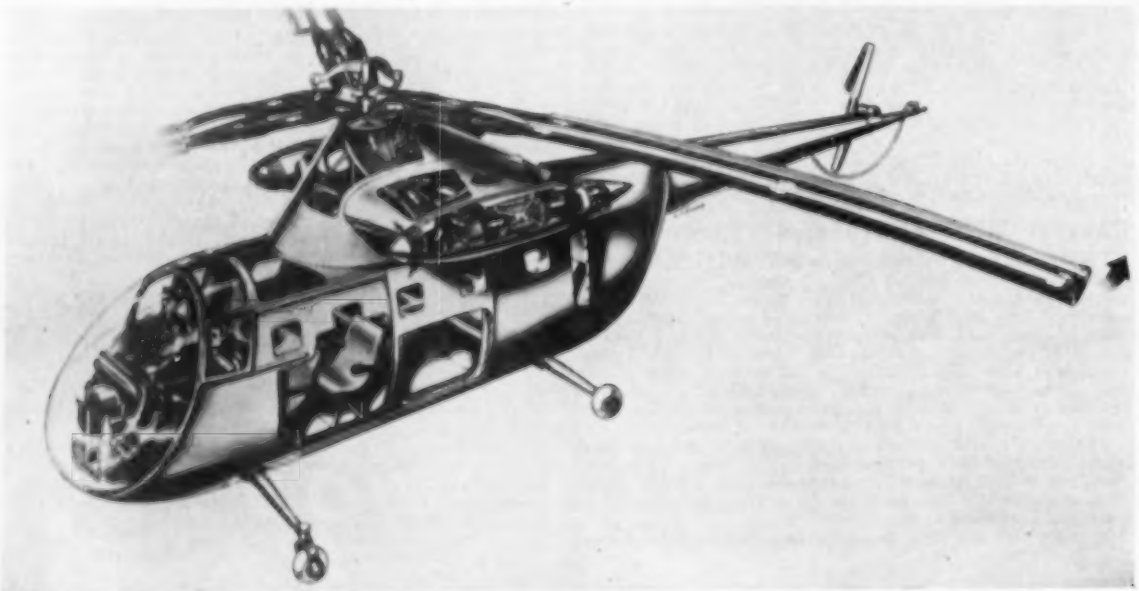
Hunting Percival's New Helicopter

ILLUSTRATED for the first time, Hunting Percival's P.105 helicopter is an advanced project making use of experience gained in the development of the experimental P.74 prototype. The P.105 is based on the same principles as is the earlier machine, but it incorporates various improvements to gain the full benefit of the inherent simplicity of the tip-driven rotor.

The two Oryx are installed "back-to-front" in outrigger nacelles, with the main compressor intake at the rear. Delivery passes through twin pipes in each rotor, rotor loads being transmitted to the hub *via* separate straps. The rotor and the gas-producing Oryx engines are arranged to form a single compact unit, complete with auxiliary gear box and tail-rotor coupling shaft. This makes possible a singular freedom in the design of the fuselage; for example, various types of fuselage can be suspended from the lifting assembly, to suit the needs of such roles as passenger transport, casualty evacuation, "crane" work, pipe- or cable-laying, and so forth.

The rotor diameters are: main, 63ft; tail, 5ft; other dimensions include: overall length and width (blades folded), 44ft and 11ft 3in; height, 14ft 3in; and usable capacity, 308 cu ft. A typical payload/range figure is: 10 passengers for 170 miles, including ten minutes at take-off power with no distance covered.

An artist's cut-away impression of the Hunting Percival P.105 helicopter project. The nacelle on each side of the rotor pylon houses a Napier Oryx gas-producer, subject of a detailed description on pages 189-193.



MARINE SALVAGE by HELICOPTER

Achievements Realized and Possibilities Foreseen

By J. W. HOGARTH

ALTHOUGH marine salvage is as old as ships themselves scientific techniques keep it as up-to-date as today's newspaper. Diving bells, articulated diving suits, observation chambers, echo-sounders, underwater television; these are examples of devices which keep salvage well abreast of the times. The latest addition to that all-star, twentieth-century cast is a helicopter. It seems destined for a bright future.

Helicopters kicked open the door to marine salvage after they had shown indisputable proficiency as lifesavers. Their air/sea rescue capabilities had led to such employment as snatching unfortunate or inexperienced yachtsmen from sandbanks. (It has recently been stated that sailing fatalities in the treacherous Hayling Island area have been halved by the advent of Naval helicopters in the locality.) Fine-weather success led to foul-weather demand. Everyone remembers the magnificent recovery of the sole survivor of the overwhelmed Goodwin lightvessel. That episode thrilled Britain, and the rescue was made in atrocious weather. Anxiously awaiting boats could approach no nearer than a quarter of a mile in the conditions at the time.

Farther afield, off Casablanca, in early 1954, the Swedish steamer *Dalsland* ran aground. Heavy swell and an onshore set prevented contact from the sea; high wind and surf pushed back attempts to reach her from the land. At that juncture a U.S.A.F. Sikorsky H-19 was offered. It succeeded in landing all the ship's passengers, with minimum delay and inconvenience. By boat, or by breeches buoy, they would have had an alarmingly wet and uncomfortable trip.

Thus established as reliable vehicles in almost any weather, helicopters came into demand for salvage. It was a natural step. The first responsibility of every shipmaster is lifesaving; the next, saving his owner's property. Shipmasters therefore turned eagerly to this new-type aircraft, which seemed capable of so much. For every inch that helicopter operators gave voluntarily, maritime users tried to extract a mile.

An early British attempt to give assistance to salvors failed. That was when the tug *Turmoil* was engaged in her epic tussle with the storm damaged American freighter *Flying Enterprise*. Royal Naval helicopters were alerted and flown to the South-West Coast. They were to transfer personnel, stores, and lines from one ship to the other. But for once the weather did beat the helicopters. Fierce gales, gusting up to the aircraft's maximum speed, kept them grounded. Then, as the weather abated in force, *Flying Enterprise* gradually rolled over and sank.

Much better luck attended a marine casualty in early 1955. The cargo vessel *Kingsbridge* had the misfortune to strand herself on the Isle of Wight. Once again orthodox methods failed, and it looked as though much valuable time would be lost. In salvage, more than in most other businesses, the "time is money" tag really is true. Each succeeding tide and almost every puff of wind sets the casualty more firmly aground. The salvage officer in charge, desperate for ideas, signalled Naval authorities at Portsmouth. They despatched a helicopter from R.N. Air Station Lee-on-Solent which solved the problem in very few minutes. Between the stranded ship and the tug was a gap of 120 yards, which could not be reduced further. The helicopter crew lowered one end of a one-inch (circumference) line to each vessel. Thus connected, the task of passing a towrope was simplified. Unfortunately the one-inch line parted first time, but the next attempt succeeded. By means of the small line, a heavier one was hauled across; then another still heavier until the tow-rope itself was connected. To owner's and underwriters' relief, *Kingsbridge* was quickly refloated.

Another type of helicopter-assisted salvage was at a ship-fire in the North Sea this summer. The steamer *Maidenhead* discovered a serious fire in her coke cargo. While assistance was being summoned the fire grew even worse and burst out of the hold. Prompt assistance once again came from a helicopter, which lowered fire-fighting apparatus and chemicals. In this case, assistance came later from H.M. ships, tugs and shore fire services. But in firefighting every moment saved is vitally important, and helicopters can render invaluable help.

In the United States, even ship-towage by helicopter has been attempted. With very small vessels, and in reasonable weather conditions, it has succeeded. But the tractive effort obtainable from present-day helicopters is small compared with a 30-ton pull exerted by only an average deep-sea tug. With the increased power of future aircraft, and provision of a spring towing hook, short tows of small-to-medium craft should be possible.

Other opportunities for the helicopter, the salvor of tomorrow, readily come to mind: Fast transport to marine casualties, for on-the-spot survey and discussion; then a return to load the requisite gear; quick off-loading of particularly valuable parcels of cargo, such as bullion, jewels or *objets d'art*; photographing of casualties for subsequent Boards of Inquiry; televising and transmitting an up-to-date picture to shore headquarters.

All these things are operationally possible. Helicopter pilots are emphatic about that. With more advanced machines, better instrumentation, and more experience in night flying they will be even more helpful. Technically, too, there is nothing that cannot be solved right now by common-sense application. Economically, as always, there may be difficulty.

Nevertheless, if British commercial salvors do not seize the opportunity, Continental firms will certainly do so. That can only result in loss of British salvage supremacy, as indeed we lost towage supremacy to the Dutch. New methods are always being evolved. Only very early appreciation and utilization of such methods can secure, or maintain, superiority.

Birmingham is traditionally about as far as one can get from the sea in England. Conversely, it is equally handy by air from East and West coasts; besides not being over-far from the Channel. It may be, that in the new concept, a central air marine salvage unit could be situated thereabouts.

NEW LIGHT AIRCRAFT AT VENICE SHOW

THE international air exhibition organized by the Aero Club of Venice is unique in that the aircraft taking part are of private-owner and sporting types, and are limited to a load of eight, including the crew. About 20 piston-engined aircraft were on show at the San Nicolo Airport, on the Venetian Lido, from July 20th to 24th, and there were also half-a-dozen gliders. The largest machine to be seen was the French Max Holste Broussard, which carries six passengers.

A demonstration was given each afternoon, with all the aircraft taking part in that held on Sunday, the 24th. By contrast to the light aircraft, the Italian Air Force Thunderjet aerobatic team made a contribution on the final day.

The three most interesting Italian aircraft (writes a correspondent) were the Tornado, the Airone and the Falco. The first is a new two-seater of all-wooden construction, made by Partenavia of Naples, and has been flying for only a few weeks. The engine is a 140 h.p. Lycoming, and the machine has a wide-track tricycle undercarriage. Maximum speed is 330 km/hr (205 m.p.h.), cruising speed 270 km/hr (168 m.p.h.), and landing speed 95 km/hr (59 m.p.h.). The Tornado was well demonstrated by the veteran Italian pilot, Col. Mario de Bernardi.

The twin-engined, all-wooden F.6 Airone first flew a year ago, when the pilot was Vico Rosaspina, who also flew it at Venice. Rosaspina has flown some 130 hours in this aircraft, and among the modifications he has suggested are tip-tanks and a longer nose, whilst the cabin windows will be extended aft. It is expected that the second Airone will be ready in September. The series machines are to have Vultur engines of 105 h.p.

It has been hoped that an Ambrosini F-7 Rondone II recently delivered to Germany would be at the display, but it failed to arrive. However, the Frati F-8 Falco was there and gave an aerobatic demonstration. This machine, again, is of wooden construction, with a retractable tricycle undercarriage, and a 90 h.p. Continental engine, giving a maximum speed of 290 km/hr. There are at present ten Falcos under construction, and it is possible that a future machine may have gas-turbine power.

In addition to the aircraft mentioned above, several very interesting visitors were to be seen. Amongst these was the Mekotow Trener Z-126, from Czechoslovakia. From France came seven aircraft: the Max Holste Broussard 7, the prototype Béarn Supercab, the Nord Norécrin II, the Jodel D-112, the attractive blue Jodel-Wassmer D-120 (which was at the Paris Show), the Paul Aubert PA-204 Super-Cigale, and the Boisavia Mercury four-seater. Also to be seen were a Morane-Saulnier M.S. 571, and a French-registered Piper Tri-Pacer. The Broussard was flown by Jacques Noetinger, who showed what this aircraft can do in the way of tight turns and steep climbs.

Gliders included three German types—a Scheibe Bergfalke II with two tandem seats, a single-seat Lo-100, and a Doppelraab-6, the latter having an interesting tandem seat-arrangement, the instructor being seated behind the pupil, but with no stick. More than 200 of these gliders have already been built. Italian sailplanes included the Zigolo CVT-1 single-seater and the CVT-2 Veltro. The span is 15 metres and unloaded weight 340 kg.

***THE PAST** brought to life—by M. Jean Salis, as he nears Dover in his reproduction Blériot monoplane. His Channel crossing, made last week, is described on page 179.*

HERE AND THERE

Holiday Airlift

FIVE aircraft, including three B.O.A.C. Stratocruisers, and two DC-4s operated by Flying Tiger Lines, have been chartered to carry a party of 362 workers and their families to this country for a fortnight's holiday. The tourists, employees of Avro Aircraft, Ltd., and Orenda Engines, Ltd., were due to arrive in stages, beginning last Sunday. This is thought to be the largest-yet private charter operation of its kind.

LOT Helicopters

POLISH-BUILT helicopters which will carry "an average of 20 passengers" are, it is reported, soon to be used on the short-haul services of LOT (Polish Airlines).

(More Than) One Man's Meat . . .

AN aerial poison campaign has begun in Central and Northern Australia in an effort to destroy dingoes and wild dogs which are attacking sheep and cattle. In three months 1,327,000 poisoned beefsteaks are to be dropped by aircraft in Queensland, South Australia, and the Northern Territory.

Canberra Record Confirmed

THE Ottawa-London speed record set up by the Canberra *Aries IV* from the R.A.F. College, Manby (as reported in our issue of July 1st, 1955) has been officially confirmed by the F.A.I. The 3,330.4 miles were covered in 6 hr 42 min 12 sec at an average speed of 799.563 km (496.825 m.p.h.). The pilot was S/L. I. G. Brown, and S/L. D. Bower and S/L. R. A. Seymour were navigators.

Shadows over Shannon

THE former president of the Irish Tourist Association, Mr. Donal F. Collins, has lately urged the formation of an Irish transatlantic airline because U.S. airlines, he says, are "ignoring Ireland." He told a Press conference that U.S. airlines were not boosting Ireland in their advertising to the same extent as Portugal, Belgium and Switzerland.

Philadelphia Aircraft Show

PREPARATIONS for the National Aircraft Show to be held at Philadelphia International Airport from September 3rd to 5th are well in hand. An indoor exhibition will display aircraft, engines, components and accessories, while an extensive flying display will include Service aircraft, permitted to participate fully by the Department of Defense. Throughout the three-day exhibition normal commercial flying activities will continue on the opposite side of the airport.

Fairey Sales Manager

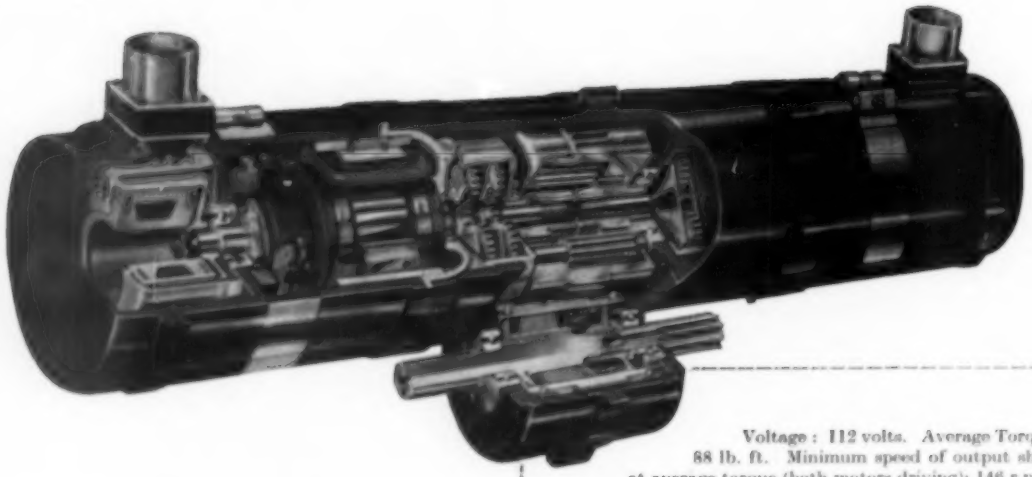
IT is announced by the Fairey Aviation Co., Ltd., that Mr. J. L. Thorne has been appointed sales manager. Mr. Thorne, who served in a temporary capacity with the Ministry of Aircraft Production during the war, later entered the administrative class of the Civil Service under the Reconstruction Competitions scheme and was posted to the M.o.S.; in 1946 he was appointed private secretary to Sir Archibald Rowlands. Since 1949 Mr. Thorne has served in the Air Division of the Ministry and for the last eighteen months has been concerned mainly with Government policy relating to exports of military aircraft.

Mr. J. L. Thorne.

***THE EASTCHURCH MEMORIAL** to Pioneer Airmen was unveiled (left) on July 25th by Lord Tedder. In the second picture he is seen with three men closely associated with flying at the Isle of Sheppey ground in the very early days: Lord Brabazon, Air Chief Marshal Sir Arthur Longmore and A. Cdre. E. L. Gerrard; the two last-named were among the first four Naval officers who, in 1911, learned to fly there. At the ceremony, tributes were paid to the Short brothers, who established a factory at nearby Leysdown and to Frank (now Sir Francis) McClean, who put the flying-ground at the disposal of the Aero Club (later to become the Royal Aero Club).*

ALL WEATHER
IS Javelin WEATHER
Fair weather or foul—the Javelin flies
and fights higher and faster than
any other fighter. It reaches 50,000 ft.
a few minutes after take-off.
No other fighter in production today
can equal the fire power,
range and radar efficiency
of the all-weather Gloster Javelin.
Gloster Javelin
ALL-WEATHER DAY-AND-NIGHT FIGHTER

GLOSTER AIRCRAFT CO. LTD., GLOUCESTER. *Member of the Hawker Siddeley Group/Pioneer . . . and world leader in Aviation*



Voltage : 112 volts. Average Torque: 88 lb. ft. Minimum speed of output shaft at average torque (both motors driving): 146 r.p.m. Max. current draw in each motor at average torque: 18 amps. Mean setting of overload Clutch : 178 lb. ft. Rating : 60 secs. Operating temp. range : +50°C to —70°C. Operational ceiling : 50,000 ft. Mounting : strap. Electrical connection : two 5-pin Breeze plugs. Weight 31 lb. Length : 20.375". Height : 8.531". Width : 4.873".

Twin Rotary Actuators

. . . each motor is fitted with an electro-magnetic brake. The output shaft is driven through a differential gearbox, the design of the gearbox is such that, should one motor fail, no additional strain is imposed on the remaining motor, which continues to produce the full torque at half speed.

A single clutch is set on the overload shaft axis. The machine is totally enclosed.

Complete Electrical Systems for Aircraft

ROTAX

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SUPER SPRITE

The First British Production-type A.T.O. Rocket Motor

IT was on April 1st, 1946, that Mr. A. V. Cleaver, who was until that date chief project engineer of the de Havilland Propeller Company, began a general study of rocket propulsion. At that time almost the only British rocket-development work was being carried out by the Ministry of Supply, largely at the R.P.E., Westcott, and at the R.A.E.; this Ministry was also formulating a specification for a liquid-oxygen motor which materialized as the Armstrong Siddeley Snarler (*Flight*, August 6th, 1954), and Faireys were also active in this field.

The de Havilland Enterprise—and the late Major Frank Halford, then chairman of the D.H. Engine Company, in particular—saw that great long-term benefits might be gained by getting into the rocket business. The first thing to do was to establish a nucleus of technicians, and Mr. Cleaver was therefore transferred to the Engine Company with the title of special projects engineer. Initially he was on his own, but Mr. W. N. Neat joined him as deputy on the first day of 1947.

The first tangible rocket experiment conducted by the D.H. Engine Company took place during 1946, when a pair of ex-German Walter 109-500 A.T.O. rocket motors were borrowed from Westcott and demonstrated with the Ghost-Lancastrian at Hatfield. These units were of the simple "cold" peroxide type, in which thrust is obtained by decomposing concentrated hydrogen peroxide into steam and oxygen, without combustion. The trial was carried out as a private venture, with the object of showing that rocket motors of this type could be handled and employed with ease and complete safety.

During 1947, the special projects department expanded and, about the middle of that year, the Ministry of Supply placed a contract for an A.T.O. motor for the D.H.106 (Comet) as an insurance against possible lack of thrust in that aircraft under adverse conditions. The de Havilland Engine Company were given a fairly free hand in the development of this motor, and it was agreed that it should be a "cold" peroxide motor, with high-test peroxide (H.T.P.) used as a mono-propellant and supplied to a reaction chamber by pressurizing the tank. Among the many advantages of such an arrangement was the possibility of rapidly achieving an exceptional standard of simplicity and safety.

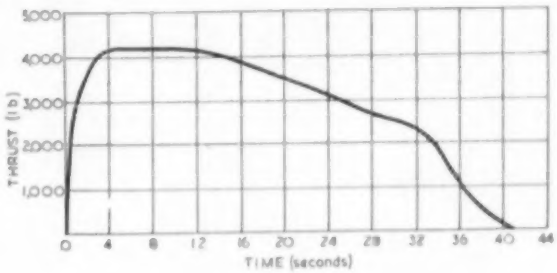
The decomposition of the peroxide was promoted by injecting a liquid catalyst into the reaction chamber, where it could mix with the H.T.P. and cause spontaneous decomposition. The catalyst chosen was calcium permanganate injected as a strong solution, and it stained the efflux from the motor to a muddy brown colour. In view of later developments this seems a primitive arrangement, but it was already a well-tried method as a result of German work.

This motor was named the Sprite and a full description was published in our issue of February 2nd, 1950. The peroxide tank had a capacity of 39 gal, and the motor was so designed that this quantity was consumed in 16 sec, the maximum thrust being 5,000 lb and the total impulse 55,000 lb-sec. The Sprite first ran as a unit in November 1949. By 1951, a pair were mounted in G-ALVG, the prototype Comet (which was then two years old), and flight trials started in April of that year. Altogether, six Sprites were made, and these completed a total of over 500 firings. Flying trials were confined to tests in the Comet prototypes, the development of the motor being entirely sponsored by the M.o.S.

Altogether, the Sprite afforded an excellent opportunity for the embryo de Havilland rocket team to acquire essential experience. Although the eventual development of the Comet nullified the requirement for the Sprite, this motor was, therefore, of fundamental importance in laying the foundation for future developments.

According to traditional definition, a catalyst is a substance which promotes or assists a chemical reaction, but which does not take part in the reaction and itself remains unchanged. Clearly, injection of the catalyst, as was done in the Sprite, was not the optimum arrangement. Not only was the efflux tainted,

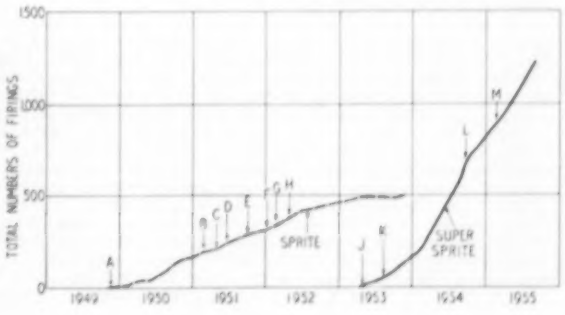
Washing-down after refuelling a Super Sprite with kerosine and high-test hydrogen peroxide in one of the test-beds at Hatfield last week.



Thrust plotted against time for typical Super Sprite operation.

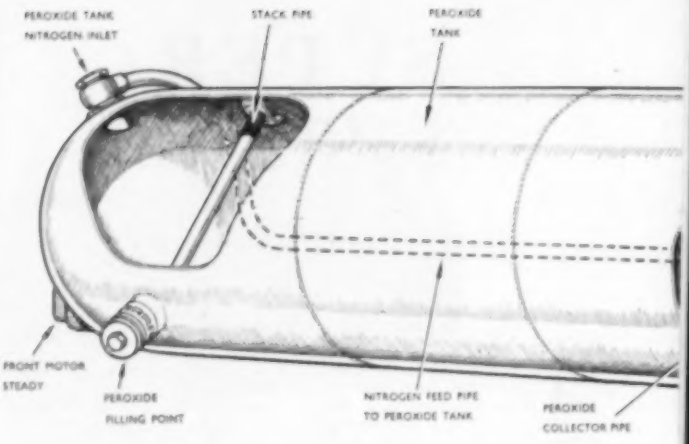
Firing history of de Havilland A.T.O. motors:—

(A) first Sprite DSpr.1 firing, 24.11.49; (B) spec. cat. flight approval DSpr.1, 2.3.51; (C) flight in Comet, 7.5.51; (D) first DSpr.2 firing, 7.6.51; (E) flight approval DSpr.2, 11.9.51; (F) as "E" (or DSpr.2 modified, 21.1.52; (G) first DSpr.3 firing, 30.1.53; (H) DSpr.2 flown in Comet, 22.4.52; (J) first Super Sprite DSpr.4 firing, 23.4.53; (K) DSpr.4 flight-approval, 14.8.53; (L) Type Approval DSpr.4 fixed installation, 22.9.54; (M) as "L" for jettisonable installation, 11.3.55.



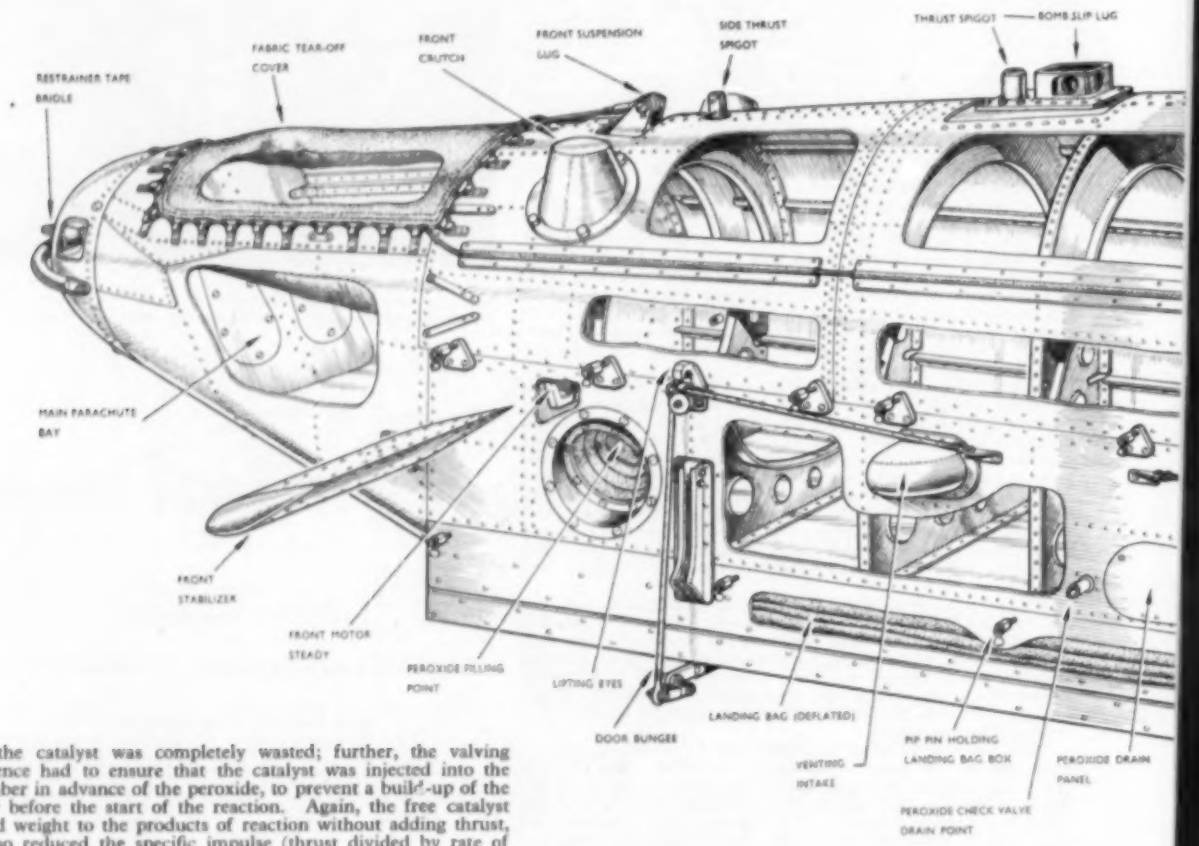
SUPER SPRITE...

These drawings are the first to be published of the production type of A.T.O. pack. The basic motor is shown above the nacelle into which it fits.



DE HAVILLAND SUPER SPRITE

Basic motor: overall dimensions, length, 117½in, diameter, 20½in. Empty weight, 620 lb ±2½ per cent; fuelled weight, 1,460 lb ±2½ per cent. Standard maximum rated thrust, 4,200 lb for 40 seconds total duration (see thrust curve); total impulse, 120,000 lb-sec. **Propellants:** 57 gal hydrogen peroxide at 80 to 85 per cent concentration and 5 gal kerosine or wide-cut gasoline. Feed by 3,690 cu in nitrogen initially at 2,900 to 3,100 lb/sq in. **Nacelle:** approximate overall dimensions, length, 150in, height, 32in and width 28in. Total weight nacelle and fuelled motor, about 1,900 lb; tail weight of expended nacelle, about 1,100 lb.

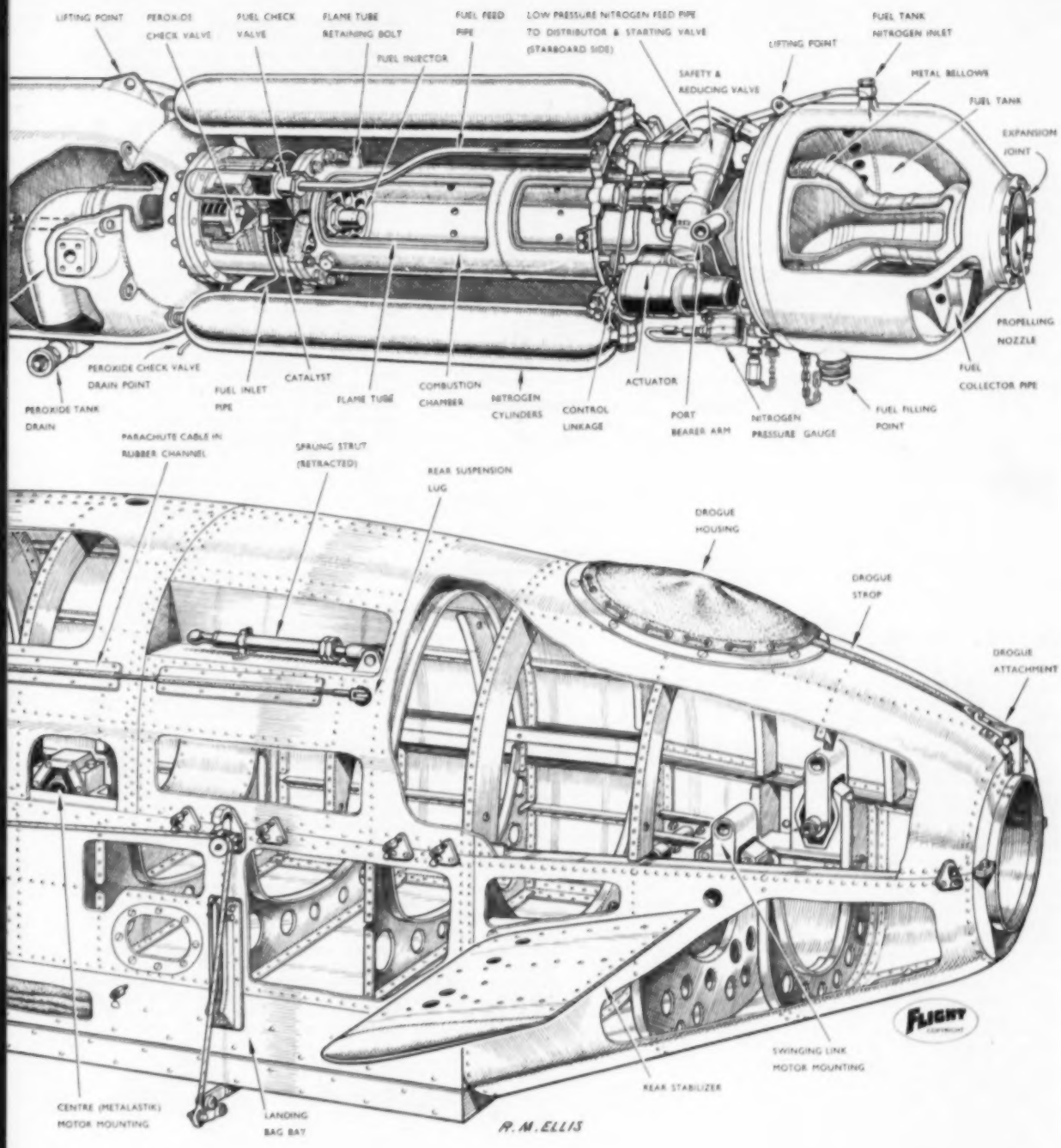


but the catalyst was completely wasted; further, the valving sequence had to ensure that the catalyst was injected into the chamber in advance of the peroxide, to prevent a build-up of the latter before the start of the reaction. Again, the free catalyst added weight to the products of reaction without adding thrust, and so reduced the specific impulse (thrust divided by rate of propellant consumption).

In any case, it was necessary only to bring the catalyst into contact with the H.T.P. in order to cause decomposition, and this could clearly be achieved without mixing both as fluids. Concentrated peroxides are decomposed by contact with a number of metals, and it seemed quite feasible to promote the reaction simply by causing the H.T.P. to flow across some form of metal surface fixed inside the motor upstream of the reaction chamber. After exploring various alternatives, it was decided that the best solution would be to inject the peroxide through an appropriately engineered assembly of a suitable metal (precise details are withheld). This would bring the entire flow into intimate contact with the metal without causing an undue drop in pressure.

Three Sprites were converted to use such a metal catalyst, with the M.o.S. designation DSpr.2. Ground and flight trials culminated in daily demonstrations at the 1951 S.B.A.C. show, in which G-ALVG gave the public their first view of the "smokeless" rocket in action. The revised motor performed excellently. The necessity of injecting the catalyst in advance of the H.T.P. no longer applied, as the catalyst was always present; furthermore, the elimination of the second fluid made possible further simplification.

In the mono-propellant Sprite, the decomposing H.T.P. formed a jet of superheated steam and free oxygen. The specific impulse of such a motor is low, at a value of about 100 (lb-thrust divided by lb/sec). The presence of free oxygen in the jet was an invitation to the de Havilland designers to inject a hydrocarbon fuel into the peroxide dissociation products, thereby greatly raising the temperature and velocity of the jet and increasing the specific impulse by 50 per cent or more. Such injection, with consequent chemical combustion—as distinct from mere decom-

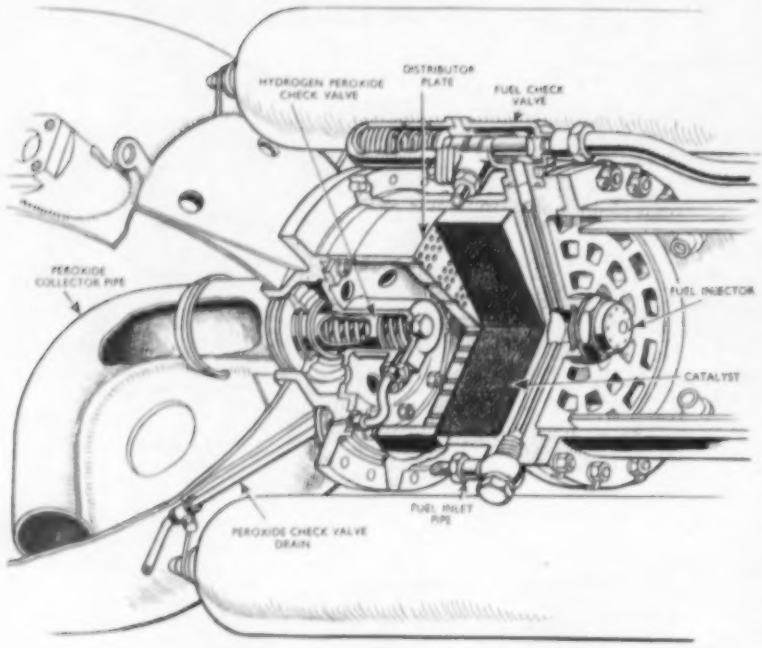


position—transfers a motor into the "hot" category. The actual combustion temperature can be varied according to the amount of fuel injected.

In 1951, the de Havilland Engine Company, on their own initiative, began the development of a bi-propellant Sprite in which kerosine was to be injected into the peroxide reaction chamber. Such an arrangement had great attraction on several grounds. For example, decomposition of the H.T.P. resulted in a chamber temperature of some 600 deg C, which was ample for the ignition of kerosine without the need for any external ignition system; further, the large flow of peroxide and steam was highly efficient in purging the system and preventing any dangerous build-up of kerosine.

By 1952, the company had proved the system by injecting kerosine into peroxide decomposition products, using a modified Sprite chamber (designation, DSpr.3). This success led the M.o.S. to place a contract, in the summer of that year, for an A.T.O. motor for use on certain military aircraft, incorporating kerosine injection but using as many Sprite components as possible. Not unnaturally, the new motor was named Super Sprite (M.o.S. designation, DSpr.4) and, although its design has of necessity been a compromise, it is worth describing in detail.

The diagram on page 187 shows in schematic form the propellant supply and control system of the Super Sprite. The motor is entirely self-contained and is basically controlled by two cockpit switches. Closure of the master (safety) switch readies the unit for firing and passes nitrogen pressure from the storage bottles through a reducing valve to a safety valve, the latter



In this detail of the Super Sprite injection assembly the catalyst pack itself has been shown in an even grey tone, owing to security restrictions on actual details of construction.

SUPER SPRITE . . .

remaining closed. The reducing valve is inserted to maintain an approximately constant 500 lb/sq in supply to the propellant tanks, irrespective of the continuous drop in pressure in the nitrogen bottles.

Firing is achieved by operating a button on the pilot's main control hand-grip, and keeping the button depressed. When this button is operated, the safety valve is opened and the nitrogen pressure is passed, *via* a solenoid valve, to the main distributor. The two distributor valves are servo-operated by the gas pressure itself, and are so inter-connected that gas pressure is fed first to the peroxide tank. Thus, the reaction chamber is initially purged with peroxide as a safety measure.

The H.T.P. is forced out of the tank *via* a stack-pipe and a check-valve which opens as soon as the tank pressure reaches about 15 lb/sq in. The peroxide is then forced through the catalyst bed and the reaction proceeds at a temperature of from 500 to 600 deg C, depending upon the concentration of the fluid. As soon as the peroxide tank is pressurized, nitrogen pressure is also applied to the kerosine tank. The fuel stop-valve opens at about 250 lb/sq in (this stage is reached about one second after closure of the firing switch) and kerosine is then forced up a stack-pipe which is so arranged that a positive feed is obtained even when the tank is nearly empty. The fuel passes along the double wall of the propelling nozzle, to provide regenerative cooling, and is then injected into the reaction chamber from a central nozzle assembly. The kerosine ignites spontaneously in the superheated-steam/oxygen mixture and burns inside the central flame-tube.

From the start of the design of the Super Sprite it was decided that the proportion of fuel to peroxide should be reduced from the stoichiometric value of 1:9 to about 1:20, which resulted in a reduction in combustion temperature from 2,300 to about 1,600 deg C. Actual combustion takes place along the centre of the chamber, surrounded by cooler decomposition products. This cooler flow mixes with the hot core in the final nozzle of convergent/divergent from which, as noted above, is fuel-cooled.

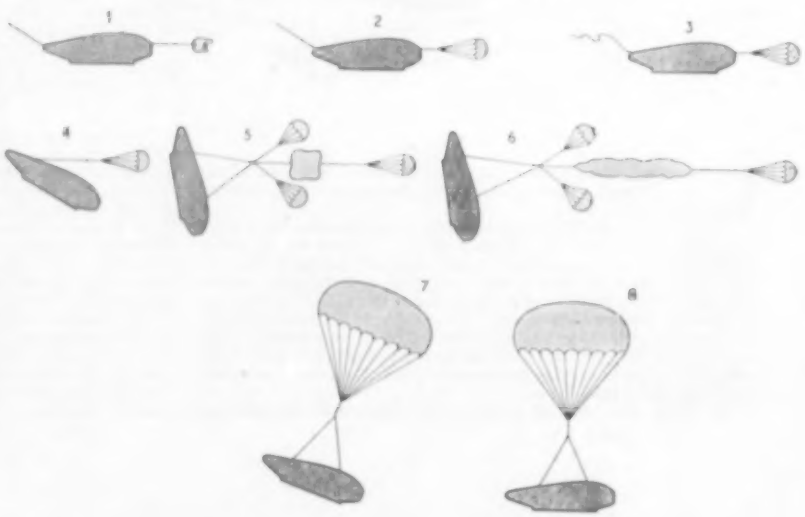
The 57-gal peroxide tank is in three portions, the centre section being added to front and rear sections similar to the two halves of the original Sprite tank. Each section starts as a disc of $\frac{1}{16}$ in stainless steel, which is deep-drawn in several cold operations by Steel Stampings, Ltd., of Kidderminster. The centre tank section is drawn extra deep and is then cut off to form an open-ended cylinder. The three sections are welded together by the D.H. Engine Company in a precision jig. All welding in the Super Sprite is done by the Argon-arc method, the resulting scale-free join being easy to keep clean (important with H.T.P.). The de Havilland company perfected the technique required.

Peroxide from the tank is forced out by pressure from nine nitrogen bottles which lie round the central part of the engine. Each cylinder is a seamless forging, by the Chesterfield Tube Company, with a capacity of 410 cu in of gas stored initially at from 2,900 to 3,100 lb/sq in. The nine bottles discharge into a single manifold.

The units of the injection assembly, including the distribution plate and catalyst-retaining grid, are steel centrifugal castings, spun with a continuous floor to permit the metal to run between the perforations, this floor afterwards being machined off. The whole assembly is retained by peripheral bolts which may be undone to permit the catalyst pack to be inspected or changed. The catalyst-retaining grid perforations are so cast that three continuous radial fuel-supply pipes can be drilled at 120-deg intervals around the casting. These lead to a central chamber into which is screwed the fuel injector, which has one central axial hole and eight surrounding radial holes.

The convergent part of the propelling nozzle is a pressing in stainless steel sheet. Similar material is used for the cylindrical portion of the chamber and the divergent portion of the nozzle, but these components are made by wrapping and welding. Heavy gauges are used in the chamber, for this unit bears the full pressure difference between atmospheric pressure and that of the burning propellants.

The flame tube is made of a comparatively light-gauge Nimonic 75 sheet, wrapped and welded to fine limits. It is retained by three bolts spaced at 120-deg intervals around the forward end; the rear end is located radially by numerous small tongues around the circumference, which slide in the cylindrical entry to the propelling nozzle and thus allow of expansion.



Super Sprite jettison sequence:

(1) Upon release at 250 kt, 600 lb pull from restrainer tape; (2) 0.3 to 0.8 sec, tape, drogue and stabilizers all at work; (3) 0.8 to 1.5 sec, tape run out; (4) about 1.5 sec, 100 to 120 kt, drogue released from rear and starts to extract 36ft canopy; (5) about 2 sec, approx. 80 kt, main pack and stabilizer canopies withdrawn; (6) at 3 sec and same speed, main canopy "squidded" prior to full development; (7) full development; (8) stable descent, air-bag doors about to open.

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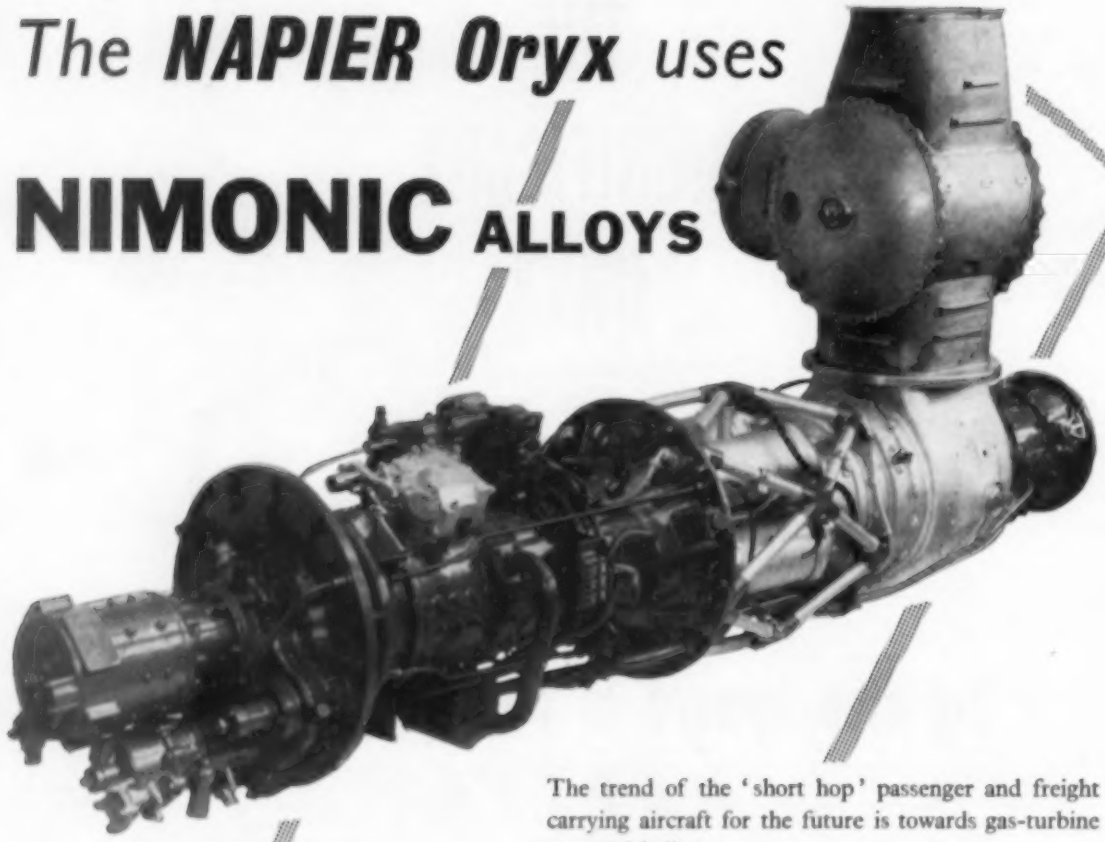

The trend of the 'short hop' passenger and freight carrying aircraft for the future is towards gas-turbine powered helicopters.

The Oryx N.Or.1 was designed primarily for such a helicopter with the rotor propelled by jet reaction at the rotor blade tips. By this means there is a considerable saving in the installed weight of the rotor-head, there being no drive shaft, gear-box, or clutch. This improves the mechanical reliability and reduces the maintenance costs of the helicopter.

Initially, the Oryx is rated at 750 gas horse power (g.h.p.) and will be installed in the Percival P.74, but development of the engine to 900 g.h.p. is anticipated.

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SUPER SPRITE . . .

In assembling the motor, the nitrogen tanks are located at their forward ends by being bolted to small lugs around the main thrust cone welded to the rear end of the H.T.P. tanks, and to which is also attached the main propulsion-injection assembly. At the rear, the nitrogen bottles are held by through-bolted connections to the common manifold ring. The kerosine tank is another product of Steel Stampings Ltd., being a cold-drawn stainless-steel sheet assembly, Argon-arc welded.

Almost all the control system and valve gear is of de Havilland design and manufacture. The valve bodies are cast in stainless steel or light alloy, the seals being of Silastic or other silicon rubbers manufactured by Midland Silicones, I.C.I., or Dowty Seals, Ltd.

In the winter of 1950-51, the D.H. Engine Company installation department was re-organized to incorporate a structural design section. At this time, the Ministry of Supply issued a requirement to the company asking whether it would be possible to produce a recoverable liquid-propellant rocket A.T.O. pack which could be dropped by parachute, and investigation of this problem has since been a major part of the department's work.

For approximately 12 months, during 1951-52, the company examined all the possible solutions to the requirement. Initially, most of the effort was applied to a nacelle with a spring-mounted, hydraulically damped landing gear, but such an arrangement was later abandoned. At this time, a pre-production contract had been received for a number of Super Sprite nacelles for the unspecified military aircraft already referred to, and it is to this machine that the A.T.O. pack has since been tailored. Unfortunately, the early development of the aircraft anticipated the use of the now-defunct Scarab A.T.O. unit, and the fuselage was stressed to incorporate attachments, one on each side, suitable for this motor.

The de Havilland company had, therefore, to develop the Super Sprite nacelle with triangulated bracing struts and an extended nose thrust-probe with a geometry identical to that already accepted by the makers of the aircraft. The fixed parameters from the outset were, therefore, the Super Sprite itself, the hanging locations and the thrust point. Within these limits, and in collaboration with the G.Q. Parachute Company, a nacelle was developed housing the motor, parachute assembly, and a system of inflatable shock-absorbing bags to cushion the shock of landing. Such a nacelle was at the last S.B.A.C. show.

The system initially adopted was the third arrangement studied, but the first actually made. Basic proving of the landing bags was done with a dummy box loaded to the correct weight, which was dropped from a crane with the box open, the deceleration upon hitting the ground being calculated. It was then comparatively easy to rig up a box with which to carry out air-dropping trials, and these were done during 1952 and 1953 from a Bristol Brigand, the belly attachments of which were modified to accept a dummy Super Sprite nacelle. Trials then proceeded with wooden mock-ups ballasted to the correct weight, moments of inertia and c.g. position, and incorporating a parachute and landing box. As it was an M.o.S. project, the Brigand was normally flown by an R.A.E. pilot.

Perfection of the jettison procedure has taken a considerable time and many difficulties have been encountered. During early trials, the main canopy did not deploy correctly, and it was found that the nacelle tended to pitch up to an acute angle (at which the nose probe could cause severe damage to the aircraft) with the accompanying hazard of lateral flutter. The methods adopted to cure such instability can best be described by outlining the complete operational procedure associated with the Super Sprite, including the jettison sequence of the revised nacelle.

In most applications so far considered provision is made for two self-contained Super Sprite packs mounted at suitable points on the fuselage or under the wings. If conditions of airfield, wind and load require the use of assisted take-off, a pair of Super Sprite nacelles are wheeled out to the aircraft and installed, with the electrical connections made, in a matter of minutes. The pack is then fuelled from a special trolley developed by the D.H. Engine Company which holds only the exact quantity of propellants required by the Super Sprite tanks. High-test peroxide and kerosine are supplied to the appropriate tanks through hoses with quick-disconnect self-sealing couplings which, to prevent dangerous mistakes, are non-interchangeable. Once cleared for flight, a functional check of the installation may be made, including the electrical firing and jettison circuits, and readings may also be taken of nitrogen pressure between the reducing and safety valves to check that the bottles are charged and the reducing valve working correctly.

For take-off, the aircraft is lined up on the runway, and the main engines opened up in the normal manner; then, when the aircraft is rolling, the pilot operates the A.T.O. master switch, which verifies that both nacelles are still connected by illuminating the jettison indicator lights. When V_{crit} is attained (the point of no return, or the critical speed at which the take-off would be continued even in the event of failure of a main engine), the pilot depresses the firing button on his control wheel—firing the A.T.O. motors—and keeps it depressed.

For speed, convenience and safety, specially designed fuelling equipment, described below, is used in operating the Super Sprite.

The first installation designed for the Super Sprite was, as already described, compromised by the fact that the aircraft concerned was already fitted to accept A.T.O. thrust loads at certain points on the fuselage. Accordingly, the original Super Sprite nacelle transmitted its thrust through an extended needle-like nose, on the end of which was a steel button pressing against a hemispherical socket on the fuselage of the aircraft. The two nacelles were independently connected on the flanks of the fuselage and were braced by an arrangement of spring-loaded struts which were arranged to fold flat against the nacelle during the initial stages of the jettison cycle.

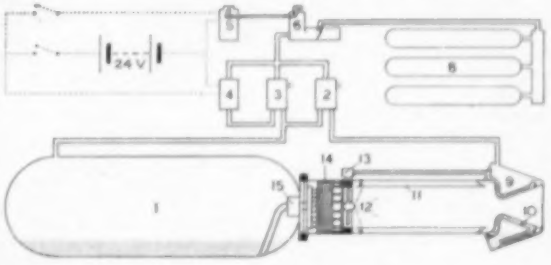
Earlier this year, however, the decision was taken to employ an under-wing attachment, which not only involves fewer compromises but makes jettisoning somewhat easier. The extended light-alloy probe on the front of the nacelle was, therefore, removed and replaced by a dished fairing, the nacelle being restressed to transmit the thrust through a spigot on top, which is located inside a hard point in the wing structure of the aircraft.

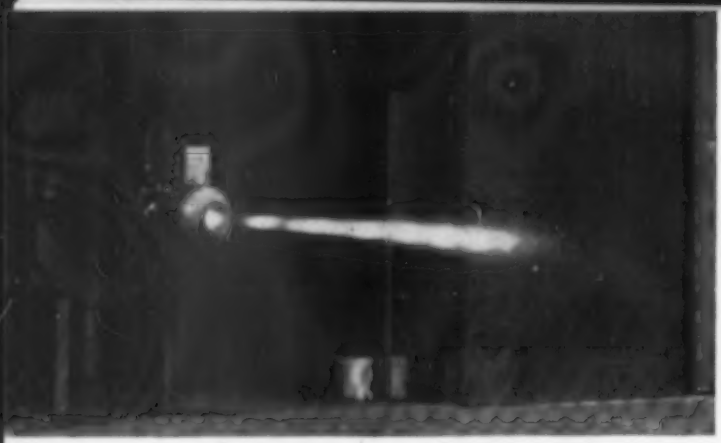
The motor is controlled by three electric circuits, all of which draw current from the 24V D.C. system. The firing circuit has already been described, and the two others are the jettison and emergency release circuits. As long as the motors are running the main pressure switches remain open, since the motor pressure is above the requisite 6 to 8 lb/sq in. Opening of the pressure switches closes the circuit to the ground firing indicators in the cockpit, which remain alight as long as the motors continue to operate. At the same time, a parallel circuit energizes a solenoid to break the contacts in the jettison circuit, rendering it impossible to jettison the nacelles while the motors are firing. When the rockets cease to fire their internal pressure drops rapidly, extinguishing the firing lights and closing the isolating switch in the jettison circuit. In the event of any circuit failure, the emergency release circuit can be brought into action. This is initiated by an independent switch in a separate solenoid circuit which energizes the mechanical side of the release mechanism.

After completing the take-off and climb-out, the pilot will normally keep his firing button depressed for a few seconds after the rockets cease to fire, in order to permit the pressurizing gas to purge all the propellant lines. The aircraft is then lined up over the recognized dropping zone at a speed of about 250 knots and an altitude between 1,000 and 2,000ft. The aiming for

Simplified block diagram of basic motor:—

(1) Peroxide tank; (2 and 3) nitrogen distributor valve; (4) solenoid valve; (5) electric actuator; (6) safety valve; (7) reducing valve; (8) nitrogen bottles (three shown); (9) fuel tank; (10) baffle around nozzle; (11) flame tube; (12) fuel injector; (13) fuel stop-valve; (14) catalyst pack; (15) peroxide inlet valve.





The flame of the Super Sprite at full thrust.

SUPER SPRITE . . .

jettisoning follows normal supply-dropping techniques and, with appropriate training, a crew should be able to put down their Super Sprite nacelles within a circle of 200 yd diameter.

At the appropriate moment, the nacelles are jettisoned by operating a double-throw rotary switch (with a centre-off position), which is independent of the master switch. This switch is moved to the left to release the port nacelle and to the right to release the starboard, the slight delay-spacing, even in a rapid "click-click" motion, being sufficient to separate the nacelles by at least 200ft and so ensure a free fall for each pack.

Standard bomb-slips are employed to carry the weight of the nacelles, and these are triggered by the jettison switch. Once released, a nacelle is free to drop vertically until the thrust spigot has completely emerged, when the nacelle can move in any direction. As the drawings show, each nacelle is equipped with a 4ft drogue, four stabilizing "wings" and a restrainer strop at the forward end. Initially, therefore, the nacelle is stabilized by the pull of the drogue (which is released by a static line) and by a corresponding pull of 600 lb applied by the restrainer strop. The latter is arranged as follows.

At a hard point on the aircraft, close to the nose of the Super Sprite nacelle, is an attachment for a small box which lies just proud of the skin. Inside the box is an assembly of 4in rollers around which is threaded 32ft of flexible steel tape. One end of this tape is coiled up in the top of the box; the other end is led out through an opening and is attached to a bridle on the nose of the Super Sprite nacelle. When the latter is jettisoned, the tape is pulled from the roller box, the resulting pull on the front of the nacelle having a very considerable stabilizing effect. The tension in the tape can be varied between 200 and 800 lb by re-arranging the run of the tape between the rollers, the value chosen being matched to the indicated air-speed during jettisoning. The tape remains attached to the Super Sprite nacelle, but the roller box is released from the aircraft as soon as the pull of the tape is removed.

As soon as the nacelle is free, it tends to assume a nose-up attitude, but the stabilizing surfaces keep the nose down and give a horizontal deployment, as shown in the sequence of sketches. When the restrainer strop has run out, a time-delay releases the drogue from its rear anchor and transfers its pull to the main canopy pack. This can be achieved by such methods as: by a static lifting apron breaking a tie and falling free; by ripping a tear-off strip and spring extractor; or by attaching the drogue to the apex of the main canopy to maintain the pull of the former during deployment. A small spring-loaded ejector chute then jumps from the top of the main canopy bay and, within half a second, the main 36ft canopy is withdrawn, together with the pair of 4ft stabilizing parachutes. The drogue is then released, to drop independently, while the main canopy gradually deploys until the entire nacelle is fully established in a stable descent.

A Bowden cable from the main rigging trips a time mechanism which, as soon as steady descent has been established, operates a Walter Kidde dinghy bottle containing nitrogen at 1,000 lb/sq in (CO_2 was originally used, but was abandoned owing to icing troubles caused by the violent expansion of the gas). The nitrogen pressure is passed through a T-piece and thence to a pair of Dunlop rams which push open two locks restraining the bungee-loaded doors over the bottom of the nacelle. The bungees then take charge, opening the two doors through 270 deg (in the manner of bomb-doors) and allowing the large landing bag to unfold at the bottom of the nacelle, under the influence of ram pressure from intakes situated underneath. This inflatable bag is attached to the nacelle around its upper periphery and has sides provided with louvres which are initially tucked in as pockets but which open under ram-pressure. The open louvres then spill off the excess air and improve the stability of the nacelle.

With a 36ft canopy the fired Super Sprite nacelle descends at about 25ft/sec. At this velocity the landing bag touches the ground, the lower surface of the bag being protected by a sheet of plywood. As soon as the weight of the nacelle is taken off the main rigging lines the no-load release is actuated, so releasing the canopy and preventing the nacelle from being dragged along the ground by the wind.

The precise recovery procedure for A.T.O. rockets of this nature has not yet been worked out in detail, but it will probably be rather more complicated than, for example, that followed during the war in recovering tow-ropes jettisoned from glider tugs. Once recovered, the Super Sprite pack would be sent to an inspection bay, where such items as the nacelle weak points, and the rubber seals and valves and catalyst pack would come in for particularly close scrutiny. Items such as the nylon cord, the explosive bolt and the anti-tilting tape roller box would be replaced. The complete unit would be passed through a service bay and would then be held in store until needed. It is at present impossible to assess the overall performance of an A.T.O. unit of this type, but it is hoped that the life will be at least 50 firings. Serious damage as a result of jettisoning should be very rare, and it may be found that this type of rocket motor will eventually equal other aircraft power units in number of operations if not in hours of firing.

The nacelle is an orthodox light-alloy stressed-skin structure, and it carries all the weight and thrust of the motor. The Super Sprite is hung within the nacelle by two main central trunnions, which are picked up by Metalastik bushes on the main nacelle longerons. These two trunnions transmit all the thrust. The rear of the motor is suspended by a pair of swinging-link trunnions, longitudinal movement being provided to allow for misalignment and thermal expansion. There is also one nose mounting on the front of the peroxide tank, which centralizes the complete motor in the nacelle.

The thrust of the motor is transmitted through the monocoque nacelle structure up to the steel spigot mounted centrally on top. Side loads are absorbed through a square-section spigot which projects above the forward part of the nacelle, and the installed nacelle is braced to the wing by four crutches. The two front crutches are fixed platforms of welded sheet, with rubber tops which can press against the wing. The rear crutches are hinged to the nacelle and can be extended at right angles to the free position to engage in circular depressions in the wing when in the firing position. The crutches are bungee-sprung to return to the free position in small compartments in the nacelle as soon as they are released, and are adjustable in length to apply the appropriate crutching load to the nacelle.

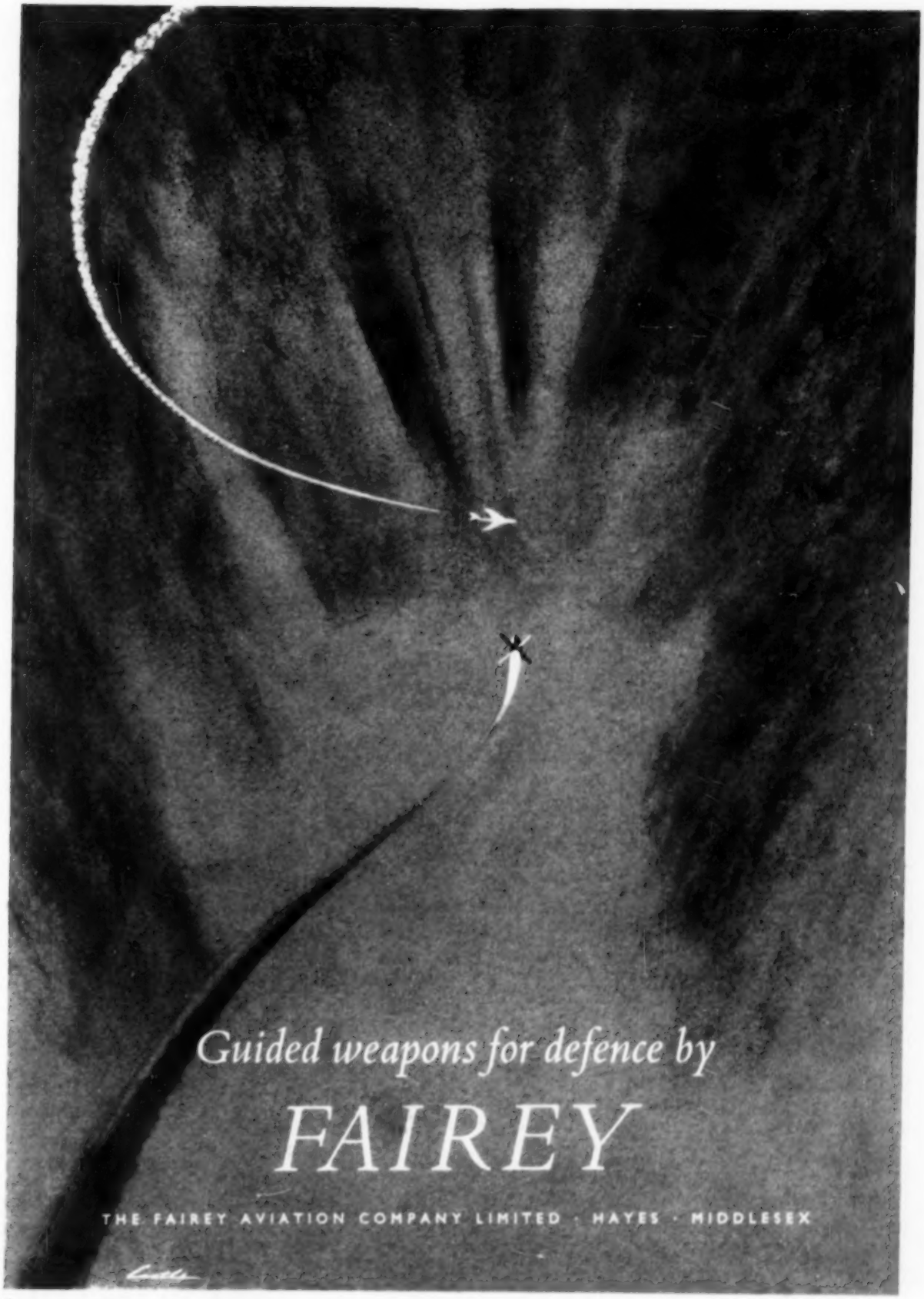
Originally, a 2ft 7in drogue was employed, but the production unit has a diameter of 4ft. It is pre-packed on an aluminium ring provided with a fabric cover, which is placed over an oval hole in the upper rear skin of the nacelle and secured by Dzus fasteners. The four stabilizing surfaces are each roughly one foot square and are simple light-alloy assemblies with three ribs carried on a steel tubular spar. They are mounted at a fixed incidence, a very considerable negative angle being selected appropriate to the angle at which the store is mounted on the aircraft.

In order to provide access to the motor, the upper part of the nacelle is arranged to lift off. The bottom part of the nacelle is a lightly loaded box containing the landing bag, the longitudinal joints between the various nacelle sections being made by Pip quick-release pins.

The anti-tilt restrainer tape is made by Trianco in 20 gauge soft steel, 32ft in length and $\frac{1}{4}$in wide. Both the landing bag and the main canopy are products of the G.Q. Company, who were also responsible for considerable assistance in developing the basic system. The main canopy is of the open-gore pattern and has a diameter of 36ft. Originally, three separate landing bags were used, made of dinghy material, but the present pattern employs a single bag made of fabric.

An accompanying diagram (p. 183) shows the development, in cumulative firings and in significant events—the Super Sprite was the first British aircraft rocket to receive a M.o.S. type-test certificate—of the de Havilland Sprite and Super Sprite. Test-bed running has established that the bulk of the unit should have an indefinite life, with the exception of the catalyst pack and various seals and gaskets which would be replaced as required. The type-test consisted of 100 firings (plus initial calibration and check firing) without modification or adjustment. A complete nacelle has also been subjected to ten drops from a crane to the full "operational" alighting speed, with intermediate firings between each drop. The basic Super Sprite is now cleared for 50 firings and, assuming that no damage resulted from the jettison and recovery cycle, it is expected that many such 50-firing lives could be achieved.

Super Sprite nacelles are now in quantity production by the de Havilland Engine Company and it is believed that the unit is the first jettisonable liquid-propellant A.T.O. motor to go into service anywhere. Various applications for the motor are currently under consideration. Development of this unit has been of inestimable value to the rocket technicians of the company who, for several years past, have been working on an increasingly broad front in the development of bigger and better rocket motors for the future.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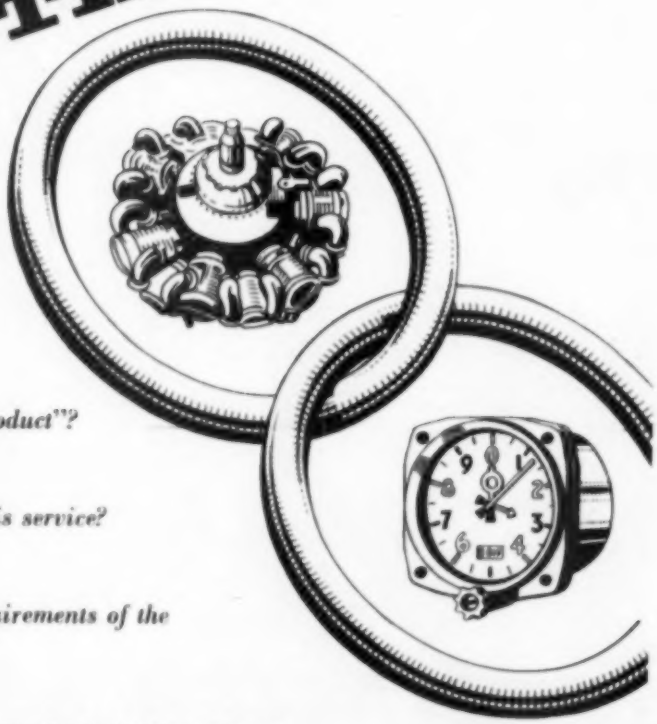

PANEL

Q. *Does this concern all aspects of Aviation Repair?*

A. YES

Q. *Is this a service rather than an "end product"?*

A. YES

Q. *Do many operators take advantage of this service?*

A. YES

Q. *Have they all been overhauled to the requirements of the A.R.B. or A.I.D.?*

A. YES

Q. *Have they all been overhauled to a high standard of "QUALITY AND INSPECTION"?*

A. YES

Q. *Then all must have been overhauled by "FIELDS"?*

A. CORRECT

(ONE TO THE PANEL)

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NAPIER ORYX

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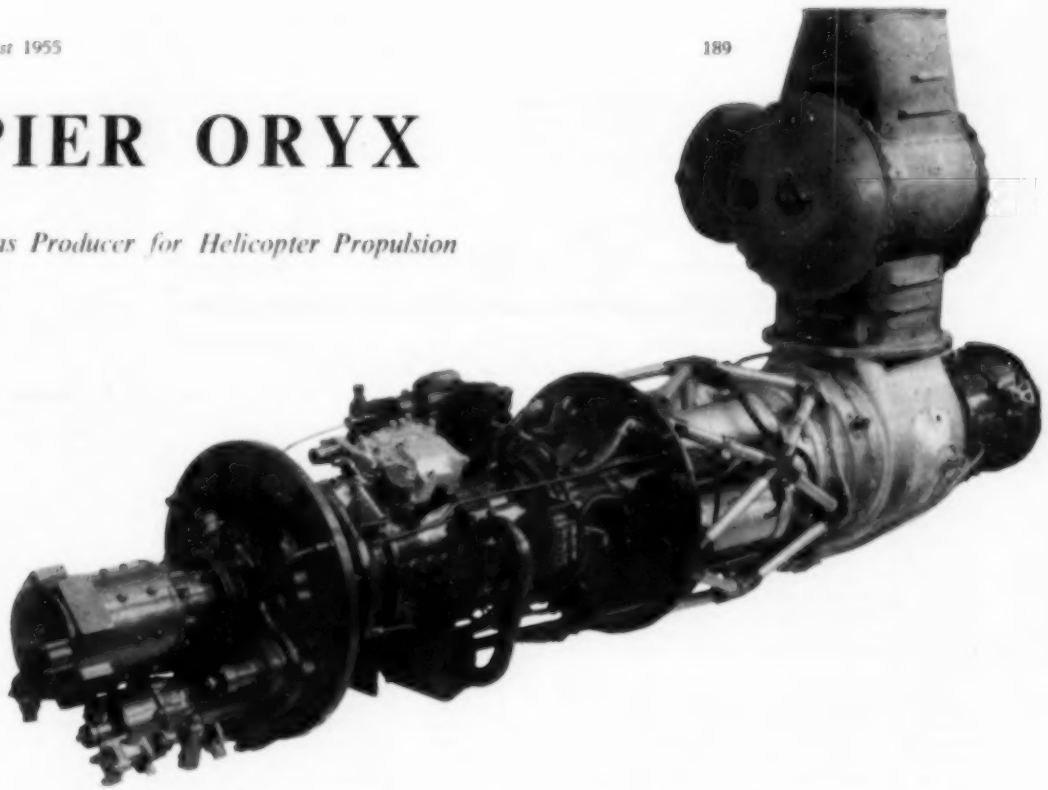


IT is now generally known that D. Napier and Son, Ltd., are paying particular attention to the propulsion requirements of rotary-wing aircraft. It is, in fact, the company's ultimate intention to market a range of engines suitable for installation in most types of helicopter; units producing shaft power and a gas delivery for tip jets are included in the programme. The engine now to be described is at present equipped solely for the latter function and it can therefore be described as unique in many respects.

The Oryx, which bears the Napier works number E.146, arose as a result of a helicopter project which was planned by Hunting Percival Aircraft, Ltd., early in 1951. Under their technical director, Mr. L. G. Frise, the latter company investigated the possibility of a single-rotor machine for which a tip-drive gas flow would be provided by a pair of small gas turbines. Reference to a curve of "power required" against forward speed for a helicopter shows that, at cruising speed, the power needed is no more than 70 per cent of that required for the hovering case at the same weight, so that, with two engines, flight could be continued even in the event of failure of one of them.

At that time the Aero Gas Turbine Division of Napiers (chief engineer, Mr. A. J. Penn) had already acquired a wide reputation for the development of high-quality small axial compressors and it was to this company that Hunting Percival turned for a small turbo gas-generator for the then-projected P.74 helicopter. A joint exploratory programme by both firms continued throughout 1951 in order to establish the design parameters.

Owing to limitations on the gauge of the material of the rotor gas-ducts, Napiers had to keep the delivery gas temperature below 400 deg C. Obviously, there were many possible arrangements for the engine, ranging from a simple turbojet (gas delivery from which would have been on the hot side) to a variety of by-pass engines. The first of the latter units to be investigated in detail would have employed an axial compressor with extended early stages of blading to provide the required flow of cool air which could later be mixed with the jet from the turbine discharge duct. It was found, however, that great difficulty attached to the efficient extraction of the by-pass flow through the shallow duct surrounding the main compressor—a problem which was aggravated by the small size of the engine.

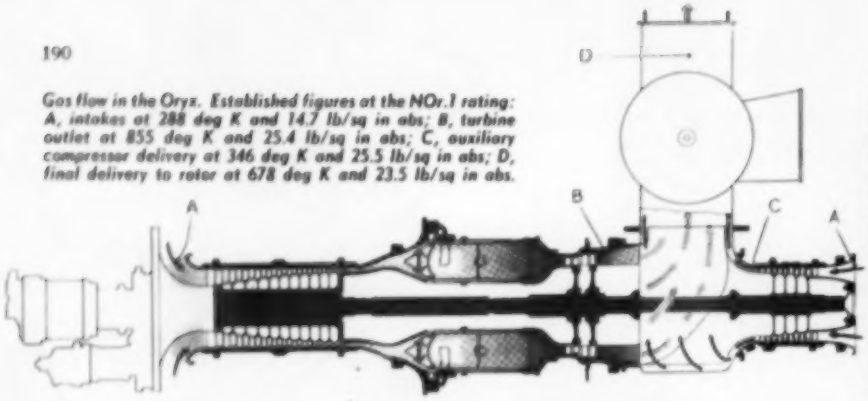
It was accordingly decided to develop an engine with a separate auxiliary compressor handling atmospheric air for mixing with the main jet. Initially, a layout was studied in which the flow through this second compressor was in the same direction as that in the remainder of the engine, but such a layout inevitably called for bifurcated turbine exhaust ducts and auxiliary-compressor inlets. In order to keep the length of the engine within reasonable limits, a considerable compromise in duct efficiency had to be accepted and it was accordingly decided to turn the auxiliary compressor back to front, so that air could be drawn in at both ends of the engine and the mixture of cooling-air and hot gas drawn off between the auxiliary compressor and the turbine section. From this happy solution grew the present Oryx.

Development of the Oryx was carried out against a Ministry of Supply contract. By the end of 1951, the gas delivery and the layout and size of the engine were settled and actual detail design started early the following year. Scale effect has a profound influence on the best attainable efficiencies in an engine as small as this, and it seems to be a fair conclusion that, in the present state of the art, an axial gas turbine cannot be made significantly smaller than the Oryx without loss of efficiency throughout the engine.

As the illustrations indicate, the Oryx is an engine with a high "fineness ratio"—a logical outcome of its unusual number of major sections attached one after the other. This is, however, no handicap, for in the P.74 the two Oryx will occupy long and narrow engine bays outboard of the main fuselage keel members beneath the floor. Ram effect is usually of slight importance in helicopter installations and it was, therefore, decided to draw air through louvred side intakes into a plenum chamber surrounding the forward part of the engine. The air then enters the Oryx through a truly annular intake behind the engine-accessory drive-face (the accessory arrangement is described later), and so passes to the compressor. The intake (together with all other aerodynamic components) was flow-tested at the company's large research station at Liverpool to ensure good velocity distribution around the periphery. At the outset the large back-plate behind the accessories was not circular, and the change to this shape was made in order to smooth out the flow and obtain the required quality of distribution. The intake itself is cast in RZ5 magnesium-zirconium alloy.

The Oryx compressor is fitted with variable-incidence inlet guide vanes, basically similar to those employed on the Eland turboprop (*Flight*, July 23rd 1954). These vanes—which, like all the compressor blading throughout the engine, are made of aluminium-bronze alloy to specification D.T.D. 197A—sit on large-diameter circular platforms at their outer ends. These platforms act as pivots, a small pip on each platform locating in a socket in a circumferential actuating ring moved by a servo (again as in the Eland). Full details of the actuating system may not yet be published, but the guide-vane angle is responsive to actual engine speed.

Twelve stages of compression are used, the aerodynamics of the compressor being based on those of a Napier research unit which gave very satisfactory performance on test. Overall efficiency is highly creditable for a unit with an overall diameter of under nine inches. There is no central shaft; the 12 discs are through-bolted end to end by nine tie-rods which have push fits in appropriate holes through the periphery of each disc. By this means, the effective "shaft diameter" and hence rigidity, is made exceptionally large



Gas flow in the Oryx. Established figures at the NOr.1 rating: A, intakes at 288 deg K and 14.7 lb/sq in abs; B, turbine outlet at 855 deg K and 25.4 lb/sq in abs; C, auxiliary compressor delivery at 346 deg K and 25.5 lb/sq in abs; D, final delivery to rotor at 678 deg K and 23.5 lb/sq in abs.

NAPIER ORYX...

—a prerequisite to the maintenance of the fine clearances necessary in so small an engine. Considerations of mechanical stiffness were also principally responsible for the attachment of shrouds around the first three rows of stator blades. Like the compressor casing itself, these shrouds and the stator-retaining rings are divided into top and bottom halves. The materials used in the compressor are Hidurax 1/12A aluminium-bronze (supplied by High Duty Alloys) for the rotor blades, which are secured by fir-tree roots to discs of S.62 steel for stages one to 11, and S.82 for the final stage. Magnesium-zirconium RZ5 is again used for the casing.

There are six main bearings in the Oryx (all by Hoffman), disposed as shown in the drawing on pages 192-193. The compressor is carried by a front roller bearing and a rear ball bearing mounted in the main support-plate casting. A muff coupling shaft connects the compressor shaft to the turbine shaft and the bearings on these shafts share a common drainage sump. In like manner, the bearings at either end of the shaft connecting the auxiliary compressor to the turbine are also housed in a common box-like structure.

A simple turbojet, with two or three bearings, can have tied shafts with compressor and turbine loads roughly balanced. The Oryx, however, has sliding couplings and the loads on the three main shafts have to be individually taken out by the appropriate pair of bearings.

In all their new engines the Napier company are taking great care to keep bearing loadings as low as possible. In the Oryx, for example, the load on the compressor rear bearing is the algebraic sum of the aerodynamic end loads, comprising pressures on the rotor blades, discs and end sealing disc, and it has therefore been necessary to keep the air pressure on the compressor back-plate as low as possible. There is, therefore, extensive labyrinth sealing, and an air-leak, discharged overboard, is permitted through the rear labyrinth seal. In order to accommodate thermal expansion of the cast support-plate, this seal is mounted on swinging links so that it remains centred at all temperatures.

Bearing-cooling is provided by oil jets. Air is tapped from the main compressor in line with the sixth rotor stage, passed through a felt filter under the compressor, and then ducted to small pressurizing chambers (at 2 to 3lb/sq in gauge) on one side of each bearing (excluding the main-compressor inlet bearing) to keep back the oil. Any excess leakage of air through the seals which cannot be accommodated by the scavenge pumps passes across the bearings and eventually into the shaft, which is breathed to atmosphere. The leakage air from the main compressor-outlet bearing and the turbine-inlet bearing (similarly for the turbine-outlet and auxiliary-compressor-outlet bearings) flows first into a large chamber surrounding the coupling shaft before entering the shaft. The oil carried by the air into the large chamber lubricates the couplings. The turbine section always remains substantially in line with the compressor and the drive is accordingly transmitted through an ordinary muff coupling. The auxiliary compressor, however, being bolted on the back of the hot mixing box, can suffer greater misalignment as a result of thermal distortion, and it is accordingly driven through gear-type couplings centred in Ferrobestos ring bearings. The latter are employed to keep the couplings central during the run-down, when the lack of drive-torque results in slight back-lash having to be accommodated.

All bearings are scavenged and will function in any of the unusual flight attitudes which may be assumed by a helicopter. The slight pressurization of the interior chambers results in an air/oil mist being forced into the interior shafting, where it is centrifuged as a spinning column, the air passing out at the auxiliary-compressor end of the shaft in a dry state. Air lost from the labyrinth at the delivery end of the auxiliary compressor passes into the canister inside the mixing chamber and reduces the metal temperatures between the oil mist and the hot canware. As a result, silicon rubbers are rendered unnecessary, ordinary black rubber seals being employed and the air finally being spilt from a downward-ejecting vent.

The inside of the support-plate is left open to the atmosphere. Surrounding the muff coupling shaft is an annular chamber communicating with five holes in each diffuser passage to the five combustion chambers. Although the air entering these holes has to perform an abrupt 90-deg turn, and thus loses its dynamic head, the static pressure is high and two feed-pipes transmit pressure from the annular chamber to the main balance piston immediately forward of the turbine section. The pressure on this piston is matched with the various turbine load conditions to reduce the bearing end loads. The high-pressure air is then taken out through holes in the shaft distance-pieces and finally flows over the back of the first-stage turbine discs and the front and back of the second-stage discs. A proportion passes through a restrictor labyrinth (which matches the considerable pressure drop across the first-stage nozzle) and escapes over the front of the first-stage disc.

To return to the description of the major components, most of which have now already been mentioned in tracing the flows of air and oil, the main compressor support-plate—which, as in all Napier gas turbines, can be considered the structural foundation of the engine—is cast in D.T.D. 708 light alloy. At its forward end, it incorporates two rows of straightener blades and then divides into five separate diffuser sections, one for each of the combustion chambers. The casting also incorporates the annulus through which is extracted the turbine pressurizing and cooling air, and a trunnion mounting attachment is provided on each side (everything forward of these attachments is cantilevered. Following typical Napier practice, the turbine section is held in an external assembly of brazed steel tubes forming a rigid frame, bolted to the back of the support-plate and forming the backbone of the engine.

The combustion system, which was designed in conjunction with Joseph Lucas, Ltd., comprises five tubular chambers. Outer casings are fabricated in S.84 and the flame tubes in D.T.D. 703 (Nimonic 75 sheet). Spherical joints are included in the outer casings to allow for slight misalignment on assembly, each chamber being articulated so that it does not fight the rigidly controlling tubular frame. As in the Eland, upstream-injection burners are fitted, and each burner can be removed without removing any other component.

Ignition is effected by a high-energy, high-voltage system of the R.A.E. type, manufactured by B.T.H. or Rotax. Igniter plugs are provided in two of the chambers, interconnectors carrying the

Three more Oryx details. From the left: components of the auxiliary compressor, with the half-casing and inter-stage stator blading removed above and the rotor below; a two-piece combustion chamber with flame tube and upstream-injection burner; and the collector, showing internal arrangement and port engine-mounting trunnion.

flame round to the other three. The combustion system has been designed to operate on either kerosine or wide-cut type fuels. The performance of the whole system so far has been most satisfactory and, on one engine, the cans have not yet been removed at 400 hr.

The rear of each combustion chamber forms the turbine-inlet casing, the inner gas passages being formed from thin Nimonic sheet, run at high temperature and carrying no load apart from that due to the dynamic head of the gas and a very small pressure differential. Air flows around the outside of these casings, passes between the turbine casing and shroud, through a final restrictor and mixes with the main products of combustion further downstream. The nozzle rings themselves are thermally free to expand, being mounted on radially sliding dogs, anti-rotational pins being employed to take the gas reaction on the blades. The second-stage nozzle blades have inner and outer platforms and are bolted to the external casing. Both stages of blades are cast in X40 material, a tungsten alloy resembling high-speed steel.

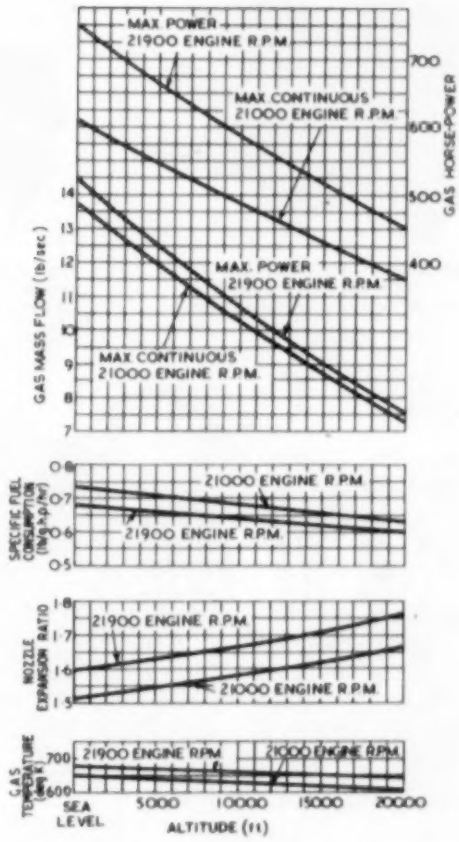
Owing to the unusual purpose of the Oryx, the turbine has to operate against a high back pressure, and the leaving velocity and swirl are such that the diffusion required upstream of the collector volute is small. Two reaction-type stages are employed, with an expansion ratio of 3.14:1. The two discs are machined from forgings in DNS 116 steel (a Napier specification) mounted over flank-fitting splines on a relatively short shaft supported at the front by a roller bearing and at the rear by a ball bearing. These two bearings are carried by strong tubular radial struts, the front set of struts being attached to the exterior tubular frame of the engine and the rear row to the turbine discharge casing.

As in the Eland, the turbine section can readily be broken up into units; for example, a seal failure during test-running was repaired *in situ* on the bed with a minimum loss of time. The rotor blading is of Nimonic 90 in the first stage and of Nimonic 80A in the second. The blades are attached by fir-tree roots which permit limited tip-rock to allow for differential expansion of the blades and discs. The first-stage blades are carried on extended platforms and a segmented ring is arranged around the first-stage rotor, the segments acting as "fire bricks," air blowing as a blanket between these segments adjacent to the blades and the cool casing.

In any gas turbine the pressure drop is far higher across the nozzles than across the turbine discs themselves and, in consequence, there remains a large unbalanced end-load across the disc in line with the inter-stage nozzle blading. A labyrinth seal is incorporated at this point and, in order to maintain the maximum concentricity of this seal at all temperatures, the disc itself is mounted on swinging links for limited radial movement.

To the rear of the turbine the gear-type coupling shaft already described transmits the drive to the four-stage auxiliary compressor. In spite of the low pressure ratio required (1.80:1) this number of stages was selected in order to obtain a compressor with a high efficiency (values of the order of 90 per cent having been obtained on test) and with wide-range characteristics. The whole assembly, including the balance-piston and seals, is mounted on a splined shaft and is clamped together by means of ring nuts. Conventional bearings are employed, ball at the inlet and roller at the outlet end. Both bearings are pressurized with clean air from the sixth-stage filter (this air is dumped into the shaft and out through the normal breathing channel to the auxiliary intake) and the roller bearing is, as previously mentioned, in the same chamber as the rear turbine bearing, to ensure oil-mist lubrication of the coupling-shaft gears.

As in the main compressor, all blading is of Hidurax 1/12A aluminium-bronze alloy, the rotor blades being secured by fir-tree roots to steel discs. All four stator stages are shrouded, the complete assemblies being bolted into the upper and lower halves of the RZ5 magnesium-zirconium alloy casing. Owing to the fact that, in the Oryx, two compressors are both matched to one turbine, a row of adjustable inlet guide vanes has, in development engines, been arranged around the intake to the auxiliary compressor (in production engines these vanes will be fixed). The setting of these vanes can be finely adjusted to the optimum value but is not variable during running. The vanes are mounted in the annular



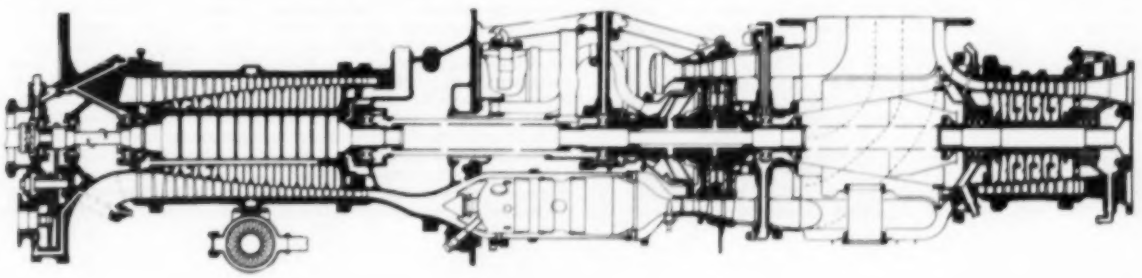
Performance of the Oryx at NOr.1 rating, plotted against altitude. This level of performance is already established, and development is progressing to higher powers.

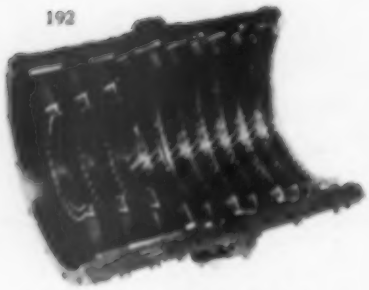
intake, which is another casting in RZ5 alloy.

There remain to be described the collector and valve units, which are items peculiar to the Oryx. The collector is situated between the turbine outlet flange and the auxiliary compressor and is a stitched and Argonarc-welded assembly in stainless Nimonic 75 sheet. As the large drawing shows, the turbine efflux is collected in a bifurcated volute, divided into stream tubes by splitter sheets, to ensure a uniform distribution at the outlet, which is turned upwards through 90 deg and exhausts vertically with an approximately square cross-section. Meanwhile, the delivery of cool air from the auxiliary compressor fills the space surrounding the hot-gas volute and thereby keeps the outer casing cool. This flow is also turned vertically upwards and is expelled as an outer tube of cool air screening the hot flow of gas from the remainder of the engine. This arrangement results in depressed metal temperatures throughout the collector, and the assembly has been shown to have a long life.

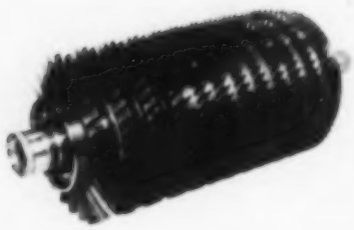
On top of the collector is mounted a two-position non-throttling valve, also manufactured of Nimonic 75. A piston-ring-sealed expansion joint is situated between the collector outlet flange and

Longitudinal section (or, in American parlance, inboard profile) of the Napier Oryx, emphasizing the disposition, and relative sizes, of the major components. The circular unit under the main compressor is the filter of sixth-stage air for pressurizing and cooling purposes.

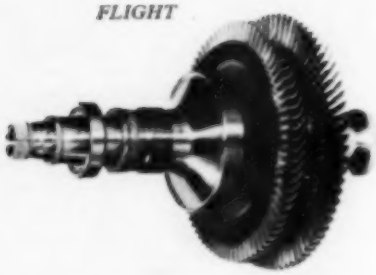




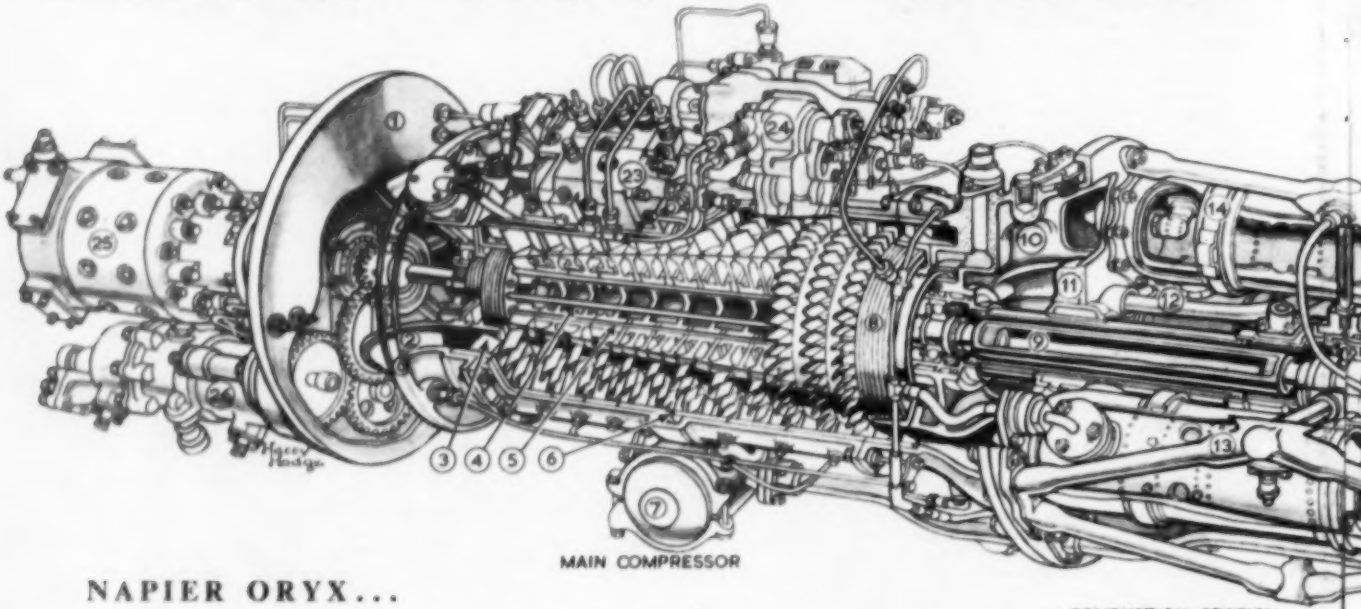
Upper half of the magnesium-zirconium compressor casing, showing shrouds on the first three stator stages.



Main compressor rotor, the aluminium-bronze blades of which are only half-an-inch high at the twelfth stage.



Two-stage turbine rotor, complete with shaft, bearing, balance-piston and labyrinth sealing (flow: left to right).



MAIN COMPRESSOR

NAPIER ORYX...

COMBUSTION SECTION

KEY TO DRAWING

1 Intake casting and accessory-drive box.
2 Intake to main compressor.
3 Variable inlet guide vanes.
4 Compressor tie-bolt.
5 Cooling-air gallery.
6 Sixth-stage air manifold.
7 Sixth-stage air filter.
8 Compressor rear-face labyrinth.
9 Muff coupling shaft.
10 Centre-support plate.
11 Annulus for pressurizing air.
12 Pipe from 11 to balance piston.
13 Tubular engine frame.
14 Combustion-chamber joint strap.
15 Sixth-stage air to rear bearings.
16 Tertiary air around inside of turbine casing.
17 Gear-type coupling shaft.
18 Auxiliary-compressor inlet guide vanes.
19 Box housing coupling shaft and adjacent bearings.
20 Collector volutes for turbine efflux.
21 Collector passage for auxiliary-compressor air.
22 Starting butterfly valve.
23 Inlet-guide-vane control unit.
24 Fuel-metering unit.
25 Electric starter.
26 Oil pump.

the two-way valve since, owing to the fact that the valve is attached directly to the airframe, there may be relative movement.

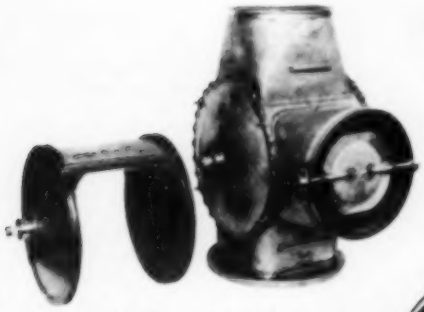
A small series of sketches on p. 193 shows the function of the valve. The back-pressure which would exist through the whole duct system between the engine and the tip jets of the helicopter rotor would be sufficient to prevent normal starting were this continuously applied downstream of the turbine. In consequence, the engine is started with the valve directing the exhaust flow directly to atmosphere, through a vent in the outer skin of the helicopter. When the engine has lit up and is accelerating, it is possible manually to close a butterfly in the starting nozzle, this butterfly having a peripheral gap of such a size that, in the throttled position, it produces a turbine back-pressure equal to that raised by the normal delivery and rotor system. With this butterfly "closed" the engine has characteristics identical with those of normal operation and, as soon as this stage of the cycle has been reached, the valve can be rapidly swung to its alternative position, blanking off the starting outlet and passing the efflux straight up into the rotor.

The valve itself is an assembly fabricated from stainless material (Nimonic 75 and Crown Max). The main movable portion has an angular movement of 90 deg, being actuated by a powerful oil servo. The unit pivots in a pair of Ferrobestos bushes and is sealed at the ends by large Wellworthy piston-rings and across its width by phosphor-bronze seal-strips pressed against the valve body by Nimonic leaf springs.

In the Percival P.74, all the airframe accessories are driven from a gear-box at the rotor head (which, in the prototype, will also drive a small tail rotor). Accordingly, the only units driven directly by the Oryx comprise pressure and scavenge oil pumps, fuel pump, and tachometer generator, all of which are grouped around the end-plate with a second casting carrying the drives through a gear-box and quill shaft from the front of the compressor. At present, the Oryx is started by a Rotax electric starter, but the engine is fully stressed for any form of impulse starter, and a cartridge, air-fuel or monofuel unit can be employed.

Dry-sump lubrication is used, an oil tank and cooler being required on the airframe. The pressure pump is of the rotary positive-displacement type operating at 150 lb/sq in, although the latter is restricted to maintain an engine oil pressure of 80 lb/sq in and a pressure of 135 lb/sq in in the non-throttling-valve servo-mechanism reservoir. The oil filter is contained within the pump housing. Each of the units comprising the three-bank scavenge pump is divided into two, so that independent scavenging is obtained for each of the six main bearings.

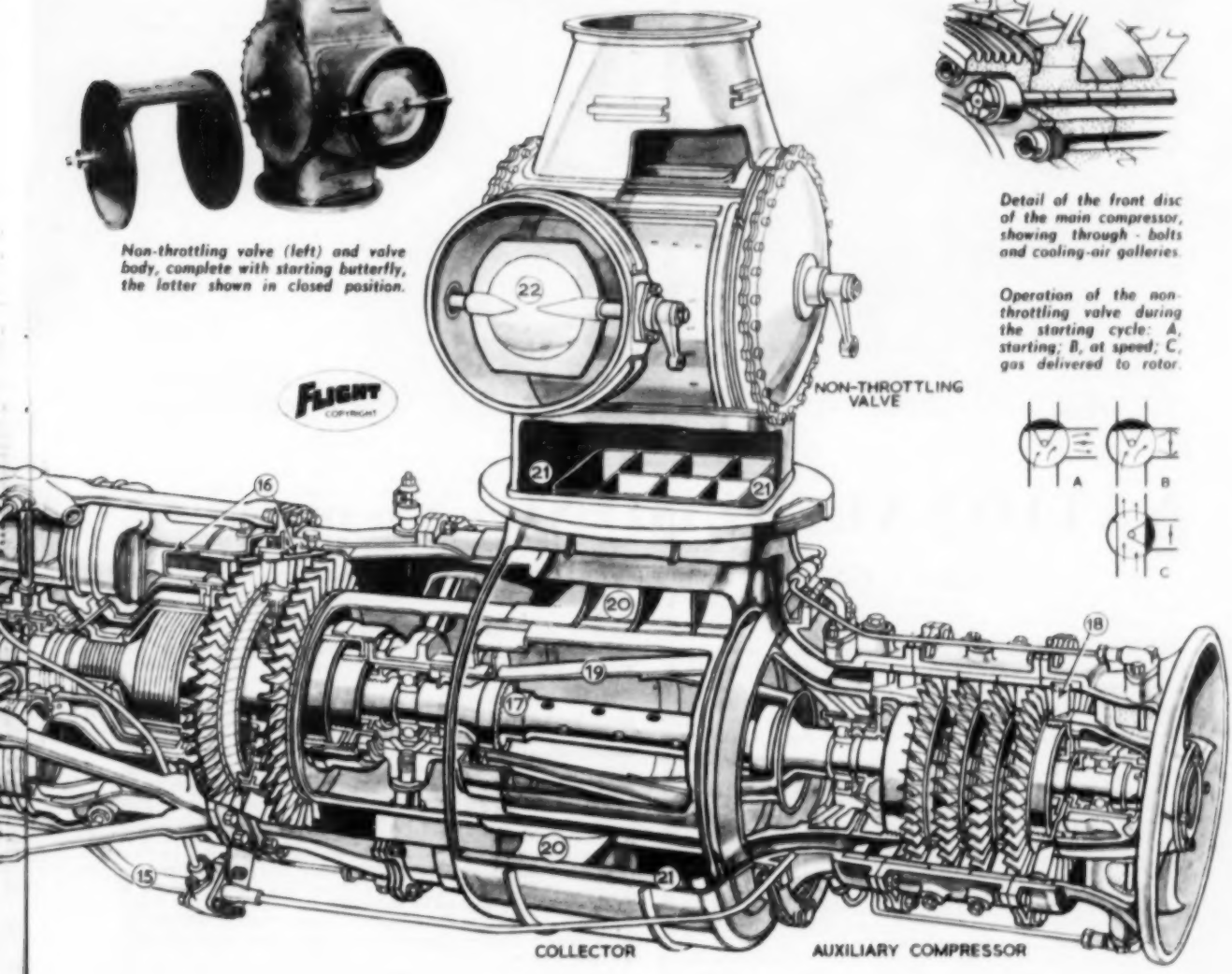
In the P.74 the two Oryx will deliver gas to a pair of ducts passing up inside the fuselage to a breeches-piece at the base of the rotor, which incorporates a bellows to permit the rotor-head to tilt. The gas will then be taken along the interior of the blades (precise constructional details of the aircraft are still withheld, although the P.105 drawing on another page is of interest), finally emerging as a propulsive jet at the blade tips. Obviously, the jets will consist largely of atmospheric air and there would thus be ample oxygen to support combustion at the tips should this be required. With tip-burning a very considerably increased disc-loading would be acceptable, although the noise level of the aircraft would be increased. There is a rotary seal on the rotor which is cooled by the same source of filtered air as is used by much of the engine. A non-return valve, of the unbalanced butterfly type, is mounted on the compressor in the duct leading to the rotor-head seal; were one engine to be



Non-throttling valve (left) and valve body, complete with starting butterfly, the latter shown in closed position.

Detail of the front disc of the main compressor, showing through-bolts and cooling-air galleries.

Operation of the non-throttling valve during the starting cycle: A, starting; B, at speed; C, gas delivered to rotor.



shut down, it would close automatically and prevent blow-back.

It is understandable that, for the time being, the Napier company are not anxious to publicize details of the Oryx control system. It can, however, be said that the engine has single-lever control operating a Napier fuel-metering unit which automatically compensates for changes in ambient pressure and temperature. The system incorporates an overspeed governor and a fixed-datum turbine-inlet temperature control; it was previously stated that the angle of the variable inlet guide vanes is responsive to actual (i.e. not necessarily selected) r.p.m. Control of the starting butterfly and non-throttling valve is effected directly from the cockpit. In twin installations, such as those in the Hunting Percival helicopters, both engines can deliver to a common duct; the manual control of the valve may then be over-ridden by a speed-sensing unit if the engines cease to run at synchronized speed. A Napier synchronizing system has been evolved for the P.74 which, in the event of failure or loss of power by one engine, automatically diverts gas from the affected engine to free exhaust.

So much for the engine as it now exists. The first prototype Oryx was first run in November 1953 and was then accepted on the Ministry of Supply contract. Since that date, some 1,400 hr running has been successfully completed and two power units will shortly be installed in the experimental prototype Hunting Percival P.74. This aircraft should fly by the end of this year.

Testing of the Oryx is rather unusual in that the quantity to be measured is the rather nebulous one of gas horse-power. This is measured by mounting the Oryx on a thrust-stand and turning the discharge duct horizontally, so that an axial thrust is developed proportional to the g.h.p. output. The actual g.h.p. is then calculated by M.o.S.-approved method; thermodynamically, the result is approximately the power which would be available were the flow to be expanded isentropically to atmospheric pressure—or, alternatively, by determining the power from a 100-per-cent-efficient turbine exhausting to atmosphere.

The design performance has already been achieved, and a type-test to the standard rating of 750 g.h.p. will shortly be attempted and preliminary development at 825 g.h.p. started. It is anticipated that the Oryx will be developed to 900 g.h.p. by the end of 1956. Meanwhile, development running is proceeding to prove the target overhaul life of 1,000 hr for hot components and 2,000 hr for the remainder of the engine. A pair of Oryx will shortly be matched to the P.74 helicopter rotor on a special spinning tower at Luton—previously a Derwent has been simulating the gas flow (picture in *Flight* of November 19th, 1954, p. 729)—and development of the 825 g.h.p. engine and P.105 helicopter is going forward.

NAPIER ORYX (at NOr.1 rating)

Single-shaft turbo-gas-generator, with 12-stage compressor (mass flow 9.9 lb/sec, pressure ratio at maximum r.p.m. 6.0:1), five combustion chambers, two-stage reaction turbine (expansion ratio 3.14:1) and four-stage auxiliary air compressor (mass flow 5.1 lb/sec, pressure ratio 1.8:1).

Maximum diameter, excluding collector and valve, 19½in; overall length, excluding accessories, 83½in approximately. Net dry weight, engine terminated at gas-collector delivery flange, 495 lb ± 2½ per cent; non-throttling valve and expansion joint, 60½ lb.

Maximum speed, 21,900 r.p.m.; direction of rotation (viewed from rear of turbo/compressor unit) left-hand; total gas delivery under take-off conditions, 14.4 lb/sec. (Pressures and temperatures are indicated in the diagram on P.190 and performance curves are given on p. 191). Fuel to specification D.E.R.D. 2482 (Avtur) or 2486 (wide-cut); oil, synthetic to specification D.E.R.D. 2487, with consumption at maximum continuous r.p.m. of 1 pt/hr.

Elegance and achievement: the champion's Sky.

"FLIGHT" PHOTOGRAPHS; SKETCHES BY GORDON HORNER

NATIONAL GLIDING

BY KENNETH OWEN

A Tug-pilot's View of the Championships: Wills Excels at Lasham

THE rear cockpit of a Tiger Moth glider-tug, if not the most comfortable viewpoint for observing a gliding meeting, is indeed an illuminating one. And this was my viewpoint for the 1955 National Gliding Championships, which ended at Lasham on Monday last. Good soaring weather and skilful flying, backed by sound organization, had produced an outstanding contest.

Winner of the individual class was gliding veteran Philip Wills, with 492 points. Tony Deane-Drummond in the Skylark III (440 pts) was second, and David Ince (430 pts) third. Team-class winner was the Empire Test Pilots School (Sky flown by Bisgood and Blake, 438 pts), followed by the R.A.F.G.S.A. Moonrakers Club (Gull IV flown by Fitzroy and Wells, 334 pts). The T-21B section was headed by the Home Command Gliding Instructors School (Jones and Williams, 361 pts).

Full results and a description of the closing days of the competitions will be given next week; this article gives an account of the flying up to Thursday, July 28th.

With Saturday, July 23rd, a practice day, and no contest flying possible due to weather on the Sunday, the first competition day was Monday, July 25th. At the morning briefing, the day's task was declared by Ann Welch, clerk of the course, to be distance along a line passing through Exeter; flying to begin at 1 p.m., when the general low cloud cover was expected to have cleared. Answering one pilot's question concerning the B.B.C. forecast of thunder that day, met-man C. E. Wallington thought this was unlikely and, in any case, "B.B.C. thunder is really second-class thunder."

It was not until 2 p.m. that the sun broke through the low cloud layer at Lasham, fairly large cumulus patches appearing. Foster and Ince in the prototype Skylark II and the Olympia IV respectively were soon away but, with thermals difficult to find at this stage, Ince was among those who were forced to land after going less than 10 miles. Subsequently (on his third attempt) he flew 87 miles to Lyme Regis, third best performance of the day.

Conditions were good during mid-afternoon and continued into the early evening, many competitors getting away successfully at a surprisingly late hour. When the landing reports had all been received, it was seen that Philip Wills (Sky) had produced his own exceptional yet expected form, with the day's longest flight to Exeter Airport, a distance of 109 miles. He had taken 3 hr 13 min for the flight, which gained him 100 points. Second with 83 pts for a 94-mile flight to Seaton, Devon, was Peter Bisgood in the E.T.P.S. Sky.

In the T-21B section, John Allan (R.A.F./A.T.C. No. 89 Gliding School) flew 69 miles but, as no other Sedbergh attained the required minimum distance, "no contest" was declared for this class. Had Allan's aircraft been marked in the "Open" section, he would have been placed seventh.

In this year's contests the Individual class and the Team class

Lasham, 1955, and launching is by aero-tow.

were grouped together in the Open section, while the T-21B section was marked separately. Tasks for the two sections were chosen by Ann Welch and John Neilan (who was also chief tug-pilot) from a range comprising free distance; pilot-declared goal; distance in a specific direction; and goal, out-and-return, and triangular races.

"Free distance" was the task set for Tuesday, July 26th, the forecast being for east-wind conditions similar to those of the previous day. The actuality consisted of an east wind considerably stronger and gustier than on the previous day, and one which made the aero-tows even more interesting—at least from the tug pilots' point of view.

The tug pilots had by this time become accustomed to the unseen hand holding their machine back on take-off (especially when towing the two-seaters): we now experienced the feeling of fingers pushing and prodding the Tiger in various directions during the subsequent towing climb, also. Certainly when subjected to so many influences—being poked in the nose by gusts, lifted bodily by thermals, having one's tail kicked around by pressure on the rope and, quite incidentally, being controlled (*sic*) by the pilot—the Tiger could be excused any possible neurotic tendencies.

Our normal procedure was to climb at 50 kt to 2,000ft, where the sailplane released, and then to regain the site as quickly as possible, dropping the rope over a marked area on our final approach to land. An intriguing concept to be remembered on the climb was that the Tiger was being flown by two pilots, not one; if the tug's nose went down, for instance, the cause would not be a forward stick-movement by the tug pilot, but rather a backward one by the sailplane pilot, causing the Tiger's tail to be pulled up.

Launching was scheduled to start at 11 a.m. Times of individual launches were decided this year not by ballot, but by the pilots booking vacant times on the launch-point take-off board when the aircraft were rigged and ready. By noon little convection was apparent, an unexpected amount of high cloud remaining above the broken lower layer, and not until 12.30 did Rivers, in the Derby and Lancs Olympia, move his aircraft out to take the first launch. He landed back after only 20 min, however, and it was not until one o'clock—when Wills (releasing at only 1,200ft from his aero-tow) seemed to be doing well—that the main rush to take launches began.

Under chief marshal Bunny Austin, the two-minute launch intervals were maintained to a close accuracy. The five Tigers, Chipmunk and Auster were turned round briskly between tows, the work of the tug ground-handlers proving extremely helpful in the gusty wind conditions. Making a singularly bouncy arrival at 2.30, after releasing Cliff Dowdall's Olympia at the standard 2,000ft, I found all the sailplanes were away.

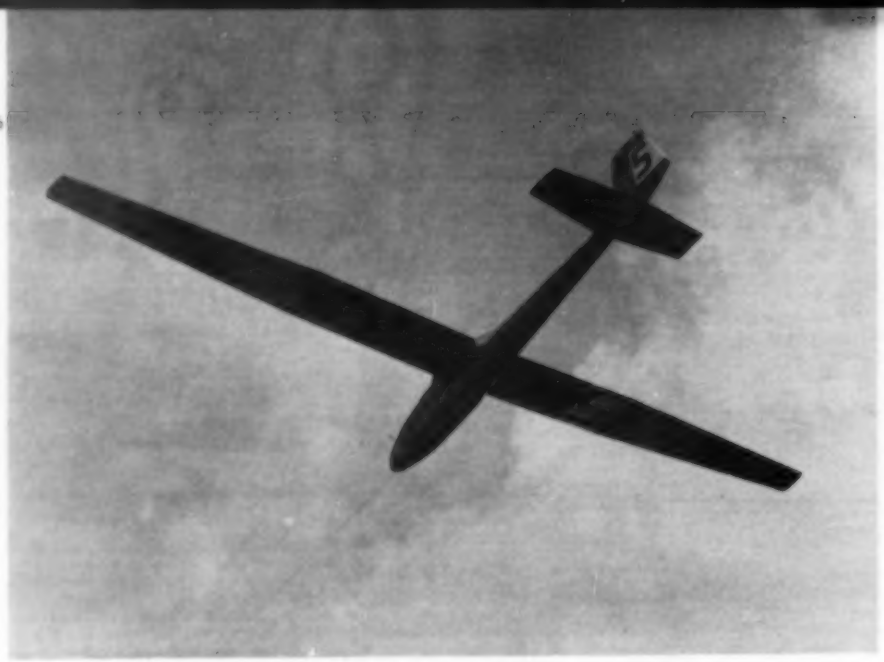
Early that evening the landing reports began to come in, and one soon caught the feeling that this was definitely one of the better days. For people were talking in terms of Weymouth, Lyme Regis, Exeter and Plymouth. When the little flags were seen spattering the map outside the control tent the picture became even clearer; they formed a continuous string out to the west-southwest, hitting the coast at Weymouth and lying in a particularly thick gaggle around the edge of Lyme Bay. Beyond Plymouth, there was one solitary flag—at Fowey, 169 miles away from Lasham. And there was no prize for guessing that this was entry No. 13; sailplane type, Sky; pilot, Philip Wills.

Foster and Deane-Drummond had both landed at Roborough Airport, Plymouth, a distance of 144½ miles; and David Ince in the Olympia IV, the only pilot to fly north of Dartmoor, achieved 141 miles to Halwill Beaworthy, ten miles from Okehampton. In the T-21B section, Robert Williams of the Home Command Gliding School, Detling, flew 82 miles to Burton Bradstock, and Alan Pickup of the Midland G.C. was runner-up with 80 miles to Bridport. The Surrey club's Olympia RedO, No. 25, flown by A. Sanders, was damaged on landing on the boulder-strewn beach near Seaton, after a flight of 94 miles. Sanders, Stuart Morison and Christopher Wills had been flying RedO in the team class; they transferred to a replacement Olympia for subsequent flights which, however, could not be officially recognized in the championship results. As a concession to those who would be travelling the road from Devon to Lasham in the small hours, "Open section" briefing on Wednesday was to be at 10 a.m., instead of nine. David Ince, whose crew encountered trailer trouble on the outward journey, arrived back just after noon.

No landing report was received from the triangular-shaped, boomerang-like flying saucer allegedly observed from Lasham

Preparing for a polished performance . . .

Slingsby T.42 "Eagle" flown by Welch and Irving.



The sharp, clear lines of the Skylark II, six of which were entered for the championships, are apparent in this photograph of Frank Foster's prototype Mark II.

Ground-handling team in action.

NATIONAL GLIDING . . .

above Philip Wills' Sky during Tuesday by both the secretary and the ex-secretary of the British Gliding Association.

Separate tasks were declared for T-21Bs and the Open section on Wednesday morning, July 27th. The two-seaters were to fly for distance along a line through Yeovilton Airfield while for the single-seat machines an afternoon race to Old Sarum (33 miles) was arranged. The weather conditions forecast, and experienced, were again broadly similar to those of the previous two days, except that the morning low cloud cover broke and dispersed somewhat earlier. The wind was again from the north-east.

The engines of two of the Tigers seemed particularly unwilling to start this morning, but the correct combination of *where* and *how hard* to hit the impulse starter was eventually found. The tug aircraft themselves did, of course, possess individual differences and, as a result, contrasting personalities, from the indescribably efficient appearance of the R.A.F. Chipmunks to all the struttery, bracery and skiddery of the shambling Tigers. G-ANDN, my usual mount, possessed a usefully angled mirror which enabled one to keep an eye on the sailplane on the leash behind; on one of the other Tigers, however, the mirror gave only the confirmation that the front cockpit was empty and that yours was the anxious face in the rear. The same machine was furnished with a wire cable running from the tail to the upper wing centre-section. To release the tow-rope, the man said, one reaches up with the right hand and tugs the wire. Surely, one thought, the bus should carry a conductor who would do that?

Individual personalities or no, the tugs combined well once more to get the competing sailplanes airborne in the shortest possible time. At about noon the first two T-21Bs were launched; there was little convection in the unbroken blue sky at that time, however, and both gliders were soon back on the site again. Just before 1 p.m. small isolated cumulus puffs began to form, and conditions had improved markedly one hour later, when all the Sedberghs had been launched and single-seater tows were about to begin. By 3,30, in splendid soaring conditions, all competing sailplanes were either on their way cross-country or gaining height over Lasham, leaving the site to joy-riding members of the public and of the B.B.C.

Soon, times to Old Sarum were being chalked up outside Control, average speeds made good being generally between 25 and 45 m.p.h. According to first reports, Dan Smith in the London Gliding Club Sky had won the race with a flight of 35 minutes, averaging 56 m.p.h. A later check on timing showed these figures to be in error, however, and yet another 100 points went to Philip Willis (54 m.p.h.) with Peter Bisgood in the E.T.P.S. Sky second (47.6 m.p.h.) and Lorne Welch (T.42 *Eagle*) third with 46.5 m.p.h.

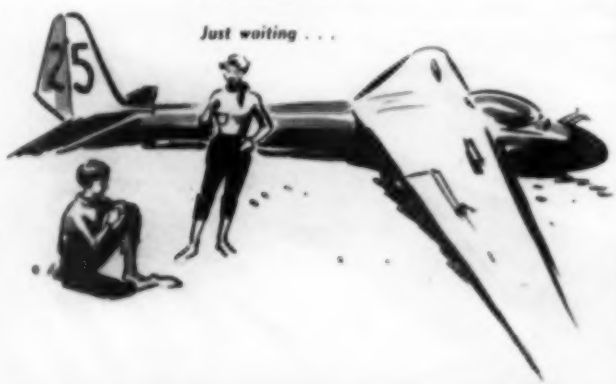
In the Sedbergh section, the previous day's winner, No. 36, again took top place with a 71-mile flight to Yeovilton, piloted on this occasion by Richard Jones. William Verling of No. 142 Gliding School (Hornchurch) was second with 67 miles.

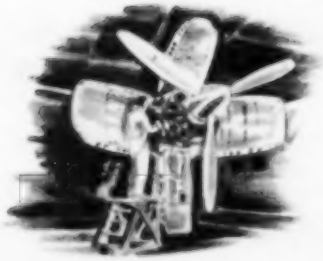
After Wednesday's flying, Wills was heading the Open section with 300 points, followed by a close group comprising Ince (230), Foster (228) and Bisgood (224). Tony Deane-Drummond with 216 points was the only other pilot with more than 200. In the T-21B section, the Detling Sedbergh (No. 36) led with the maximum 200 points; the Hornchurch entry (No. 142 Gliding School) was second with 138; and in third place with 134 points was the Midland Gliding Club's aircraft, No. 41.

A more northerly wind was experienced on Thursday, July 28th, when the Open section task was again to take pilots along the A.30 (or so it seemed) to the south-west of England. Distance along a line through Yeovilton was the object. Dry thermals up to 5,000ft were forecast, together with extremely strong thermals in the isolated cu-nims to the west. The Sedbergh's task, originally a race to Tarrant Rushton, was changed (due to the presence of jet aircraft around that aerodrome) to pilot-declared goal. The first launches were scheduled for 11.30 a.m. By mid-afternoon, Lorne Welch in the *Eagle*, and Kenneth Fitzroy in the Moonrakers' Gull IV, had both reported landing at Bridport, a distance of 80 miles. With 19 results to come in, they led the Open section. At the end of the day, however, it was Philip Wills once more, with a 139-mile flight to Plympton, Devon; second was Dan Smith with 128 miles.

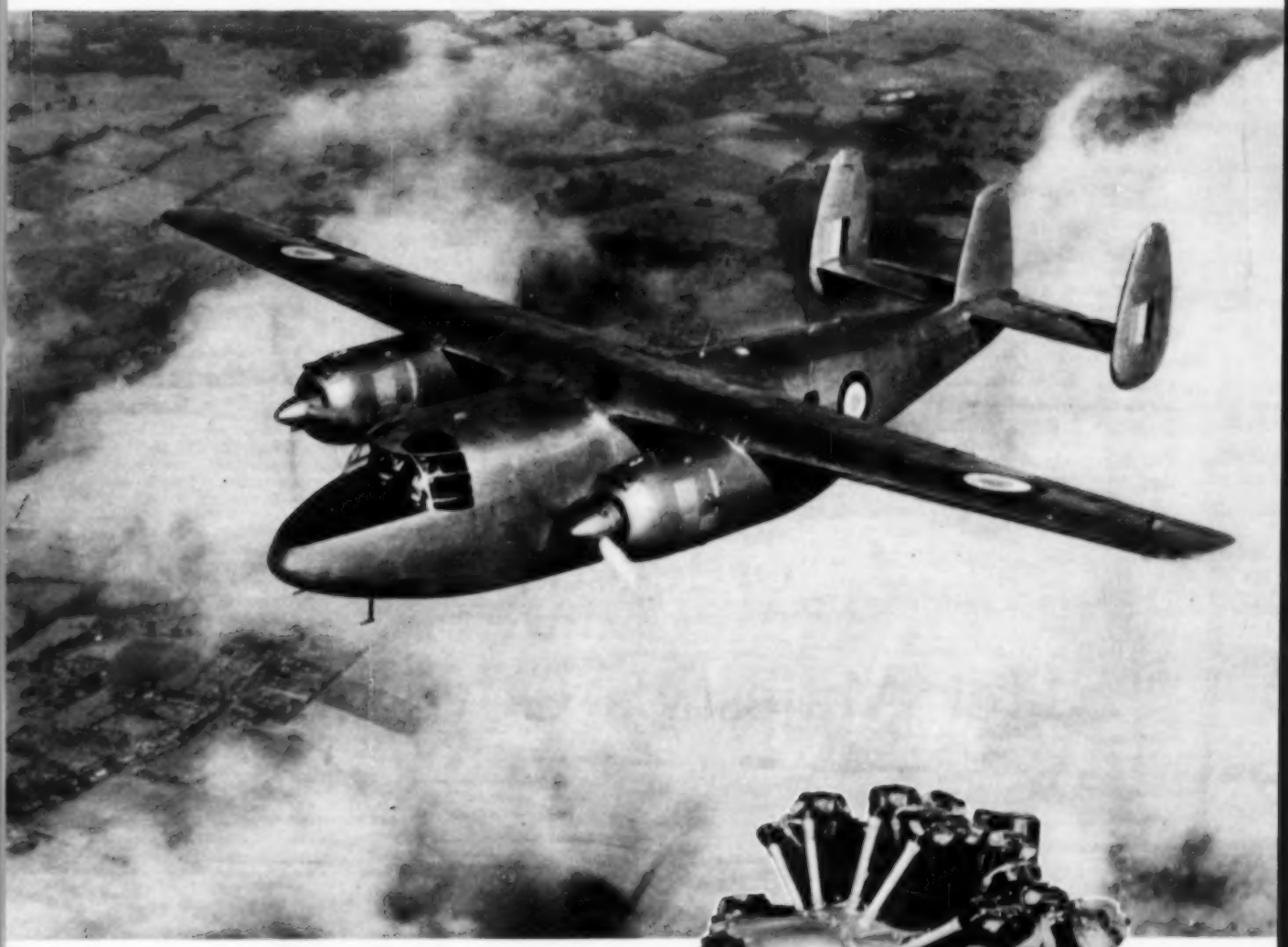
(To be concluded)

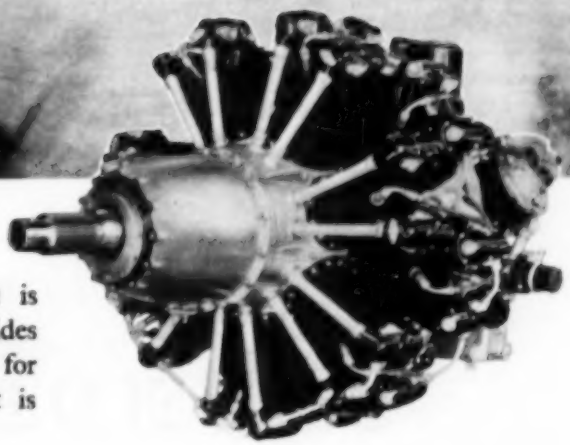
Just waiting . . .





Flight Testing the Major





A very intensive flight test programme is now being carried out on the Leonides Major Marathon to prepare the Major for the many important roles for which it is already scheduled.

ALVIS LEONIDES MAJOR

ALVIS LIMITED ALVIS COVENTRY ENGLAND

SKEETER Mk.6

ordered by

Her Majesty's Government

The Saunders-Roe Skeeter Mark 6 is powered
by a de Havilland Gipsy Major 200 engine

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"Hydro-lift" is the American designation of the water-skid undercarriage fitted by the All American Engineering Company to the Bellanca Cruisemaster in the upper picture. The Convair DF-102A is a recent production machine, finished in the new U.S.A.F. intercepter colour scheme of grey with certain items, e.g., anti-dazzle patch, in green. Note reversion to the original type of canopy.

AIRCRAFT INTELLIGENCE

Great Britain

V-Bomber Performance. Some indication of the altitude capabilities of the Avro Vulcan and Handley Page Victor is afforded by a pronouncement in America. According to *Aviation Week*, fighters of the U.S.A.F. and U.S. Navy which are fitted with the Pratt and Whitney J57 turbojet are currently restricted to cruising altitudes more than 5,000ft below the operational ceilings of the two British bombers. The J57, of course, powers some of America's most advanced high-altitude fighters and bombers.

U.S.A.

Lockheed C-130A Hercules. At a recent demonstration the third production C-130A, making its third flight and flying at maximum landing weight (with a load exceeding eight tons), left the runway in 900ft and landed within 600ft. It was authoritatively stated that the Hercules can carry ten tons at 350 m.p.h. for 3,000 miles, and that the type will begin to equip the 18th Tactical Air Force next year, replacing the Fairchild C-119. The principal difference between production C-130As and prototypes is that the Allison T56 turboprops, rated at 3,750 e.s.h.p., deliver some 500 h.p. more than the YT56s in the prototypes.

Fairchild M-225. This designation covers a light jet transport designed specifically for executive use and having a cruising speed of 560 m.p.h. It is planned to use four Fairchild J44 turbojets or other units of similar thrust (1,000 lb). Span is only 35ft 4in, length 50ft 10in, gross weight 17,695 lb, and range 1,280 nautical miles, with maximum fuel. Seven passengers will be carried in addition to the crew of two. At maximum weight, take-off distance to 50ft is quoted as 5,720ft.

North American Jet Trainer. A proposal has been submitted to the U.S.A.F. for a jet-propelled development of the T-28 piston-engined trainer, subject of a general-arrangement drawing on this page in the issue of July 22nd.

Convair SC-54 Conversion. Convair have begun the conversion of a number of Douglas C-54 transports for search and rescue work with the M.A.T.S. Air Rescue Service. Redesignated SC-54, the aircraft will carry extra internal fuel and the necessary range of electronic and radio equipment.

Piasecki YH-16A Transporter. Powered with two Allison T38s, this large helicopter recently flew at Morton, Pennsylvania. In the meantime, modifications have been put in hand on the first YH-16, which include replacement of its Pratt and Whitney R-2180 piston engines with Allison T56s.

Canada

Avro CF-100. The makers state that the weight of this all-weather fighter is "approximately 37,000 lb". Range is "over 1,000 nautical miles" and ceiling "more than 45,000ft". The Mk 3 is powered with two Orenda 9s, of 6,500 lb thrust apiece, and the Mk 4 with two Orenda 11s, each with a thrust in excess of 7,000 lb.

Australia

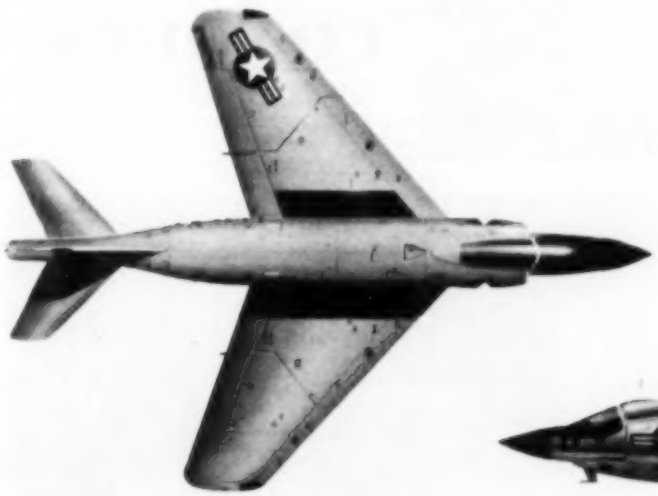
Lockheed C-130A Hercules. The Australian Government, which is now considering the purchase of modern freighters, has been informed that it can have twelve Lockheed C-130A freighters by March 1957. A news item on the C-130A appears on this page under "U.S.A."

France

Morane-Saulnier M.S.760 Paris. The Paris prototype continues its demonstration tour of the U.S.A. Up to July 18th it had completed 113 hr 11 min flying, involving 252 landings. The number of passengers carried was 529. Demonstrations have been given at Dayton, Columbus, Detroit, Chicago and Minneapolis.

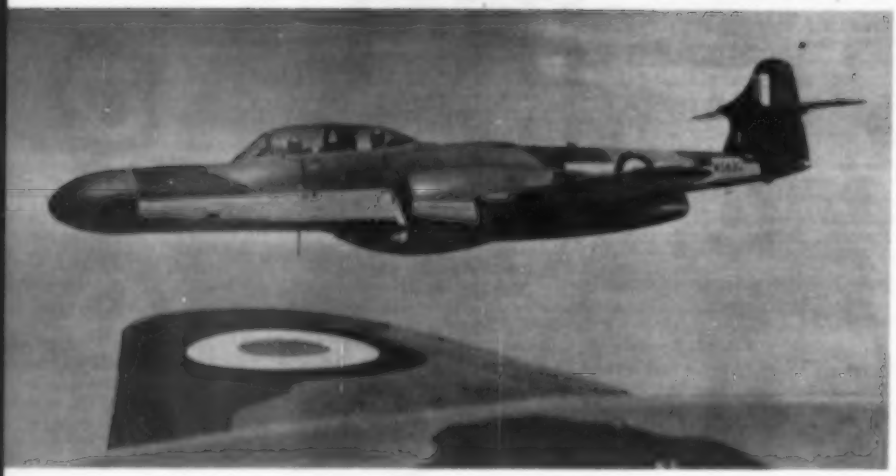
Italy

Fiat F-86K. The first seven North American F-86Ks assembled by Fiat at Turin from American-supplied components were handed over to American authorities on July 25th. The aircraft were thereupon handed over to the Italians.



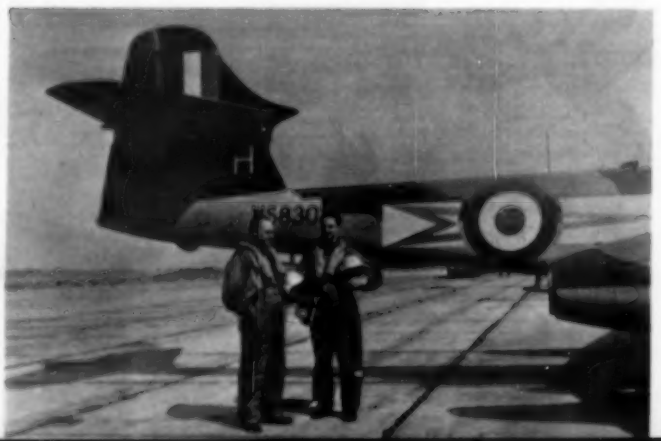
McDONNELL F3H-2N DEMON
(Allison J71, with afterburner)

Span	35ft 4in
Length	47ft 6in



THEY RISE TO CONQUER

THE loftiness of the sky in the uppermost of these Russell Adams pictures is further heightened by tenuous contrails thousands of feet above the Meteor N.F.12s and 14s. These all-weather fighters belong to No. 46 Squadron, R.A.F., the motto of which is adapted as our title. In command is W/C. F. E. W. Birchfield, O.B.E., A.F.C., who is seen on the right with his navigator, F/O. P. J. Wilde. This picture, too, shows the squadron marking (a red arrow on a white ground) and the distinctive tail of the wing commander's machine, with a black fin and a red rudder. The same Meteor—an N.F.14—is the subject of the air-to-air picture above.



IN MEMORY of MF and MF/DF

Looking Back on Earlier Days of Air Radio

By P. OOMEN*

RECENTLY I found on my desk, among other papers, a *Notice to Airmen*. It was just a short *Notam* containing only a few lines, and there was nothing in it of spectacular importance to civil aviation. Nevertheless, reading it brought to the foreground of my mind a host of memories of a time when civil aviation went through one of its greatest throes of expansion; a time which, in my memory, is associated with the requirement for the highest degree of professional skill in the conduct of radio communications.

The *Notam* merely mentioned that the services on medium frequencies (MF), and the associated direction-finding service (DF) would be discontinued as from January 1st, 1955, at the aeronautical radio station in Amsterdam and other locations in the Netherlands. As I said above, there is nothing spectacular about this; we have seen many *Notams* with similar contents, and we will, no doubt, be seeing many more in the near future. The old MF radio service is dying and it is only a matter of time before not one station will be left.

Still, MF communications and MF/DF should not pass into oblivion unnoticed; it has performed too valuable a service for aviation to deserve such a fate. The elimination of radio communications on medium frequencies marks the close of an era in radio communications in civil flying without which aviation in the Eastern Hemisphere could not have developed as it did. Let us for a moment sit back and review what this communication system has done for air transport, how it has worked and how it was organized, finally to be almost perfect.

Nowadays it is customary, even among communications experts and at international communications meetings, to sneer at the old days of radio telegraphy on medium wavelengths; it is considered a cumbersome, slow method of conveying intelligence; at best, a tolerant smile is the only reward for the courageous soul who dares speak up for MF communications and say that they performed the best that could be expected with the state of the technique at the time.

However, as a last tribute to MF, let us review the development of communications for aviation and bring back to our memories the experiences on the frequency 333 kc/s, the QDMs, QTFs, QBIs and QBBs.

As early as 1912 tests took place in order to develop a system of radio correspondence between the ground and the aircraft, and naturally, World War I contributed greatly to the development of ground-to-air and air-to-ground communications. Simultaneously with the start of civil aviation in 1919, radio communications for this new mode of transportation were initiated. During these first years of civil aviation radio telephony was used, but, as air routes expanded and greater distances had to be covered, radio telegraphy was found to provide more reliable communications; also, it seemed less liable to suffer from interference. In those early days the short waves (below 100 metres) were, for all practical purposes, not yet "discovered", and all communications took place on the so-called "medium wavelengths", notably on and around 900 metres (333 kc/s).

In Europe there was another, very important, reason for changing from telephony to telegraphy. As international aviation increased more and more, the problem of different languages became a great obstacle in the use of telephony. In radio telegraphy the use of codes and abbreviations for a multitude of commonly used expressions not only overcame the language problem, but also ensured faster communications. The use of radio telegraphy spread from Europe over practically the entire Eastern Hemisphere. At first communications traffic was of such a nature that the pilot, or the co-pilot, could handle the radio installation; but soon it was found that the presence of an experienced radio operator on board the aircraft greatly improved overall communications. Gradually, all civil aircraft equipped with radio apparatus, except those engaged solely in short-distance flying, carried a radio operator as a member of the crew.

While at first radio communications in aviation followed the practices and procedures of the merchant marine, aeronautical communications in time developed their own characteristics. The nature of aviation demanded certain specific requirements which called for fast and reliable communications and the possibility of exchanging a variety of information, between the ground and the aircraft, within a very short time.

These requirements resulted in an expansion of the Q-code used by the merchant marine. With the Q-code it became possible to exchange information on practically all subjects that might be needed in aviation, in a manner which could be communicated with great speed and which overcame the language difficulties inherent to radio-telephony. Some of these Q-signals have since become widely known not only to radio operators, but also to all who have been actively engaged in aviation. To mention only a few:—

QDM	The magnetic course to steer with zero wind to reach me is . . . degrees.
QAH	My height is . . . metres.
QTF	The position of your station, according to the bearings taken by the direction-finding stations which I control is . . .
QFE	Present barometric pressure, not reduced to sea level, is . . . millibars.
QBI	Poor visibility rules are in force.
QGO	Landing is prohibited at . . .
QAA	I expect to arrive at . . . at . . . (time).
QBB	Base of the low cloud is . . . metres.

As air traffic increased, improved procedures and techniques were required; and the operating skill of the communications personnel, on the ground as well as in the aircraft, became greater and greater until it reached a perfection never before attained.

Here it should be said that I am speaking of the Eastern Hemisphere in general and of Europe in particular. On the North American continent an entirely different system developed. Early tests and early radio communications in the Americas and the rest of the world followed the same pattern for a while; but the change from radio telephony to radio telegraphy was never made on the North American Continent. Almost simultaneously with the first development in civil aviation, North American communications took into use high frequencies (below a wavelength of 100 metres) instead of medium frequencies (above 100 metres). These high frequencies were found to offer certain advantages which, coupled with the absence of language problems, permitted the continued use of radio telephony. However, they were not suitable for another development which rose to great heights of perfection in the Eastern Hemisphere, namely, that of the direction finding (DF) service by ground-stations.

We cannot here divulge the interesting subject of the differences in aviation practices, procedures and application of technical facilities in the Western Hemisphere as compared with those used in the Eastern Hemisphere; differences in philosophy which created problems of which some are unsolved even today. One of these differences in the philosophy of radio communications was that, in the Western Hemisphere, each airline (or operating agency) had been allotted frequency channels for its exclusive use; in the Eastern Hemisphere the radio frequencies were always considered to be international property, open to users of all nationalities.

Forming the Network

Meanwhile, in Europe, C.I.N.A. (*Commission Internationale de Navigation Aérienne*), a body which had been established pursuant to the International Air Convention of 1919, developed procedures and operating practices for civil aviation, such as for communications, meteorology, etc. Although C.I.N.A. was not world-wide, a substantial number of States were members, and its work formed the basis on which, after World War II, I.C.A.O. was founded. C.I.N.A.'s headquarters were in Paris, at 60bis Avenue d'Iéna, now one of the I.C.A.O. regional offices.

Together with the development of radio-communications in Europe the need was felt for navigational aids to aviation. It would be going too far if, in this article, we tried to follow this development and review the various possibilities that might have been pursued. We can, therefore, only mention that in the course of years an extensive network of ground-operated direction-finding stations were organized in Europe and, in fact, over a large part of the Eastern Hemisphere. The technique made it possible to determine the direction in which an aircraft lay from a ground station and, if bearings were taken simultaneously by two or more stations, its position could be established as well. The system, however, called for highly experienced and skilled operators at the ground stations. The availability of such experienced personnel, on the ground as well as in the aircraft, made it possible to develop the operating techniques and procedures to perfection.

As in the case of the radio-telegraphy communications, the procedures to provide radio bearings to aircraft followed at first the practice used by the merchant marine; then new practices and procedures, more adapted to the needs of aviation, were introduced. In the merchant marine there is usually comfortable time available in which to take a radio bearing or series of

* *Technical Officer, International Civil Aviation Organization.*

IN MEMORY OF MF AND MF/DF . . .

bearings in order to determine a position. Much less time was available in aviation; aircraft speeds demanded an instantaneous reply to the request for a bearing or a position. If, in a ship, it takes five minutes to determine a radio-bearing from a beacon, the vessel will in this time have moved one kilometre; in a comparable length of time an aircraft (at pre-war speeds) would move twenty kilometres.

In order to satisfy the requirements for a quick reply to a request for a bearing, watch on the air-ground communication channels was carried out with the direction-finding apparatus itself. The direction finder was equipped with a scale divided into 360 degrees, over which a pointer could be moved. To determine the bearing of an aircraft (which for this purpose transmitted a "dash" of approximately ten to fifteen seconds duration), the pointer was moved to a position where the signal-strength was minimum; the reading on the scale would then indicate the direction of the aircraft relative to the DF station.

The main communication stations worked in close co-operation with each other, and with secondary DF stations under their control. The system of a main station with a number of auxiliary stations made it possible that the position of aircraft could be accurately determined. When an aircraft requested a QTF, all stations within the network took radio bearings and transmitted their results to the main station. There, the bearings were plotted on a map and the position of the aircraft determined. This procedure sounds cumbersome when described on paper; actually, only one minute was required.

The success of the communications and direction-finding system on medium frequencies was to no small measure due to the great enthusiasm with which the radio operators carried out their tasks, and to the pride they put in operating their stations to the best of their ability. The work required presence of mind, a cool head and great skill in handling of radio communications. How stringent the requirements were is borne out by the fact that of all the radio operators employed at a radio station, only about 15 per cent were able to cope with the traffic on the frequency 333 kc/s.

The standard of operating was about the same for all stations in Europe, and the operators jealously guarded the good names of their stations; these must not be jeopardized by errors or clumsy working-methods or by a colleague not yet up to the required standard. I cannot speak too highly of this period, and I always proudly think of the time when I was one of those permitted to conduct radio communications on 333 kc/s; I will always regard that time as the one which gave me the greatest satisfaction in the performance of my assigned task.

Manners on the Air

There was a certain code of good behaviour and politeness in radio-communications in those days. This code required, for instance, the exchange of signals such as GM ("good morning"), BJR VX ("bonjour, mon vieux"), TU ("thank you") and PSE ("please"). Failure to observe the rules of elementary politeness in radio communications was very strongly disapproved of. Although the radio operators of the various ground stations in Europe did not know each other personally, they nevertheless knew one another from the way in which they handled the morse-key. The manipulation of a morse-key, the rhythm and the specific characteristics of the signals, identified an operator, just as a person can be recognized by his voice.

As a rule, an aircraft did not have to call a ground station more than once. If it did happen that a first call passed unnoticed, the ground-station operator would feel greatly ashamed; and if, for instance, he heard the signal "PHA de GED QRZ FNABC" ("Amsterdam from Croydon, you are being called by the aircraft FNABC") the operator at Amsterdam would be feeling really embarrassed.

The speed with which information could be passed between skilled operators was much faster than the layman usually believes. A simple message from an aircraft—indicating its altitude, including establishment of the communication, transmission of the message and acknowledgement by the ground station, would not take more than about ten seconds. I have mentioned already the necessity for speed. As air traffic increased the radio frequencies in use became more and more crowded until, just before World War II, overloading of the channels began to be apparent, calling for greater experience on the part of the operators. More channels were required, but the normal process of gradual expansion of services had to be interrupted on account of the war.

It is obvious that the amount of communications traffic was greatly increased during periods of bad weather, especially when the visibility was poor. Aircraft had to be kept informed of the weather situation, and numerous messages had to be exchanged for air-traffic control purposes. In addition, aircraft required more frequent radio bearings than during the clear weather.

The practice of requesting QDMs developed into a valuable system of radio-aid-to-landing; but before enlarging on this development it would seem useful to give some figures on the accuracy of radio bearings in general. During the day-time the range of the medium frequency communications was about 300 km, which was, in Europe, sufficient for all practical purposes—because of the composition of the networks of stations and the delineation of the control areas of the main communication stations. Accuracy of the radio bearings was usually plus or minus one degree, often greater, and an accuracy of less than three degrees was not considered satisfactory. For the determination of a position, bearings from three different ground stations were considered necessary, and the result should show as a very small triangle or, at ranges less than approximately 200 km, the bearings should go through one point on the map. At night, however, the normal DF apparatus was subject to so-called "night error" which made bearings unreliable. Fortunately, with a specially constructed aerial it was possible to eliminate this night error; but the antennae system required careful construction, it had to be large, and erected away from buildings, power lines, etc. Therefore, night-error-free systems could be installed only at the main stations. At short distance, night error was not pronounced.

The problem of effecting landings under poor visibility conditions has, of course, been a headache ever since aviation started. It would bring us too far if we attempted here to review the various endeavours to find a solution to this problem. The history of the development of radio aids to landing makes interesting reading, but we have to confine ourselves to the rôle which MF/DF played in this field. The QDM procedure was soon found to be an excellent method of being directed to an airport. If the aircraft continued to request a QDM at frequent intervals, and if it followed the course supplied to it by the ground station, it inevitably had to arrive over the aerial system of the DF station. This procedure was used extensively and developed into a system whereby a separate DF station, constructed specially for this purpose, was installed in the approach path for one or more runways and, usually as close to the threshold of the runway as was compatible with the height of DF aerial (four to five metres high and of light construction). When an aircraft wished to use the system for landing, it changed to a slightly different frequency and started a series of requests for QDMs. The practice was that the aircraft operator would press down his key for about five or six seconds, then listen for the result of the bearing, which was given to him in the form of a course to steer; he would repeat this process until the aircraft passed over the direction-finding station and on to the runway. This method worked fast and smoothly, but, obviously, it required considerable skill from the operators, both on the ground and in the aircraft.

The system was later perfected by the installation of another direction-finding station which could take "cross bearings" of the aircraft while it was nearing the runway on the approach path and while being directed by QDMs. With this system it became possible to tell the pilot not only the course to steer but also his distance to the runway. A further improvement was that the operator in the aircraft continuously transmitted a dash on the medium frequency and the pilot told by the ground station, by radio telephony, the course and distance. Thus, during the approach, when fast direct communication between the ground and the pilot was a necessity, the intermediate stage of the aircraft radio operator was eliminated.

There were still other developments, all using the same basic principles. There was, for example, the ZZ procedure, used extensively in Germany, by which the pilot was advised when he could descend below the clouds.

In all these systems, in communications with the aids to air navigation, the human element played a great rôle, and each person participating in a major or minor capacity did so with great enthusiasm and pride in the profession. The radio operator, who had assisted in the safe landing of an aircraft under sometimes extremely poor weather conditions, felt a satisfaction which he will always remember.

Medium-frequency communications and direction finding contributed greatly to the regularity of civil aviation in the Eastern Hemisphere; without MF/DF it would not have been possible for the airlines to adhere as closely to schedule as has proved possible; certainly not in a region so invested with bad weather as is Western Europe.

And now, MF and MF/DF are dead. They have been replaced by other systems of communication and radio aids to navigation, using other frequency bands. Radio telegraphy has again been replaced by radio telephony for short and medium distances and is being replaced by radio telephony for long distance. This is not the place, nor would it be appropriate for me, to evaluate the two systems; we are in a different era, different considerations count, and different, better, techniques can be applied. The natural development of an industry must follow its course, or it would become incapable of further growth.

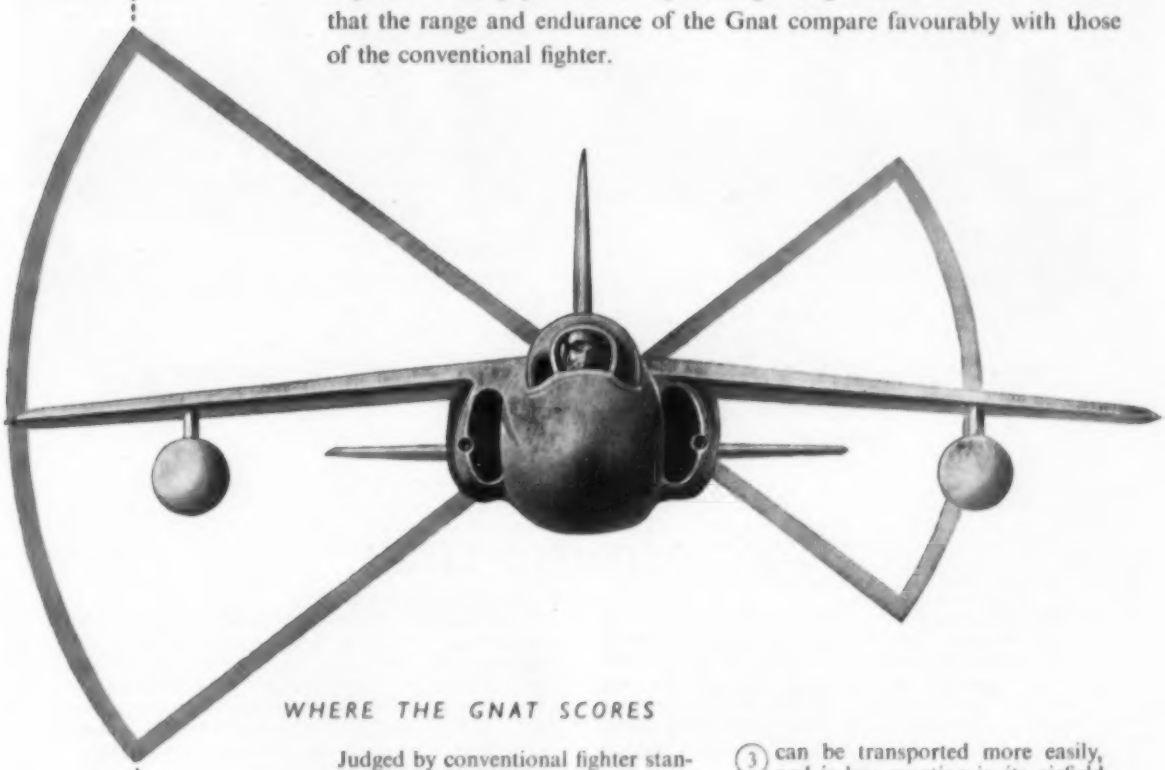
Still, we should at this point pay tribute to the services rendered by MF and MF/DF during a period when aviation became increasingly dependent upon reliable systems of communication and radio aids to navigation.

(2) MERITS OF THE GNAT

Radius of Action

The Gnat light fighter has an operational range and endurance at least equal to that of the conventional fighter. On a sortie at high altitude, making full allowance for take-off, climb, combat and slow return to base, a radius of over 500 nautical miles is obtained with under-wing tanks — and more than half this distance can be flown on internal tanks alone.

In terms of military load and fuel carried, a comparative weight analysis shows that the Gnat has an advantage of some 8% over the conventional fighter. This advantage is gained from the compactness and simplicity of its structure and equipment, and the singularly high thrust/weight ratio of its engine. Utilising part of this percentage weight bonus for fuel ensures that the range and endurance of the Gnat compare favourably with those of the conventional fighter.



WHERE THE GNAT SCORES

Judged by conventional fighter standards, the Gnat:

(1) has a higher service ceiling, higher rate of climb and superior manœuvrability.

(2) requires fewer maintenance hours.

(3) can be transported more easily, and is less exacting in its airfield requirements.

(4) is easier to produce.

(5) costs far less to buy and operate.

FOLLAND PIONEERS OF THE LIGHT JET FIGHTER

FOLLAND AIRCRAFT LIMITED · HAMBLE · SOUTHAMPTON · HANTS

B.C. 25,000,000 Model

Why there is no 1955 model of the Scelidosaurus will never be very clear. His compact all-purpose design looked good for many more millions of years. Apart from a tendency to overdo the ivory trim (he kept adding a horn or a spike once every hundred thousand years or so) Scelidosaurus seemed a promising starter in the race for survival. So his disappearance remains a mystery.

In the manufacture of new aircraft designs, such mysteries are avoided by careful prediction based on patient research and experiment. One way of insuring against mysterious failures of fuels or lubricants under abnormal conditions is to submit the problem in advance to Esso. They probably have the answer already waiting for you on the files—if not, they will spare no effort to find it for you.

It pays to consult

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ESSO PETROLEUM COMPANY LIMITED, 36 QUEEN ANNE'S GATE, LONDON, S.W.1. *AVIATION TECHNICAL SERVICE, RELIANCE 1261*

THE INDUSTRY

Steel-ring Production

STEEL rings for the ball bearing and aircraft industries are being produced at the rate of sixty an hour in a new ring-rolling plant at the works of Steel, Peech and Tozer, Rotherham. Formerly, these rings were made by ring-hammer forging, a slow method of production.

In the new plant, blanks cut from round bar are pierced on a 400-ton press and rolled to the required dimensions on a special mill in about 60 sec each. The complete installation, which includes a rotary hearth reheating furnace in which the blanks are brought to the required temperature before processing, is controlled by only five operators.

The plant, which is the only one of its kind in the country, can produce rings weighing up to 2¼ cwt., with an outside diameter of up to 50 in.

Successful Plastics Exhibition

VISITORS to the British Plastics Exhibition held at Olympia from June 1st to 11th totalled 35,150, including 1,781 visitors from 74 countries overseas. These figures compare very favourably with those of the previous exhibition in 1953, which attracted 27,850.

The convention which ran concurrently with the exhibition was also well attended, and more than 600 visited the sessions dealing with glass-reinforced plastics.

For the next exhibition, in 1957, which is expected to be international, the organizers—*British Plastics*—have booked the whole of the Grand Hall, gallery and annexe at Olympia—a total floor space of 196,000 sq ft. This will provide almost twice the stand area previously used.

Viscount Air-conditioning

AS described in our issue of July 15th last, the air conditioning and pressurization of the Viscount built for service in North America is the joint responsibility of Sir George Godfrey and Partners, Ltd., and the American AiResearch Company. We quoted the director of engineering of Trans-Canada Air Lines as saying ". . . we use Godfrey cabin superchargers from England [but] we use AiResearch pressurization controls from the United States. We think this combination is unbeatable at the present time." The key to our large cut-away drawing listed AiResearch as the manufacturer of the cold-air turbine unit; this unit is, of course, the well-known Godfrey-type CA-7.

Of low build, to enable it to pass under aircraft wings and tails, this new Esso servicing vehicle carries 200 gal of lubricating oil and 100 gal of water/methanol. Designed for one-man operation, such units are in use at London Airport, Prestwick and Shannon. The makers are the Steel Barrel Co., Ltd., Uxbridge.

Magnetic Pick-up

THE range of magnetic sweeps manufactured for service on airports and roads by the Witton-Kramer Electric Tool and Hoist Works of the General Electric Co., Ltd., has recently been extended by the introduction of a new trailer-mounted equipment incorporating its own engine-driven generator for supplying power to the magnets, which have an effective width of 72in. The normal magnet-to-ground operating gap, when the trailer is being towed at 5 m.p.h., is 3in, this value being correspondingly decreased for speeds up to 10 m.p.h.

Multi-purpose Tankers

TWO new Shell-Mex and B.P. tankers will shortly go into operation at London Airport. Each carries a total load of 825 gal. Two compartments hold, respectively, 400 and 200 gal of lubricating oil; another three tanks are fitted for carrying, respectively, 75 gallons each of de-icing fluid, hydraulic fluid and water/methanol. The vehicle, based on the Dennis Pax chassis, and with tanks and auxiliary equipment by Thompson Bros. (Bilston), Ltd., is powered by an 86 b.h.p. Dennis four-cylinder petrol engine.

NEW U.S. LIGHT-AIRCRAFT RADIO

A NEW model of the Narco Simplexer V.H.F. transmitter/receiver for light aircraft has been announced by the National Aeronautical Corporation of Ambler, Pennsylvania. With 27 channels it can provide all the 25 crystals commonly used for airport and in-flight communications in the U.S.A. All these lie between 118.1 Mc/s and 122.8 Mc/s except the in-flight channel, which is 126.7 Mc/s; and the special small crystals fit into the same space as previously occupied by the 12 crystals of the earlier 12-channel equipment. The transmitter is of unusually high power and a special aural tuning signal allows manual tuning of the receiver without looking at the dials. Total weight of the equipment, with power supply, is 10.3 lb; price, with 25 crystals, is $480 (about £172).

The Simplexer equipment, with Omniplexer mounted above.

An omni-navigation attachment, called a Narco Omniplexer, and weighing only 2.2 lb, can be mounted directly on top of the standard Simplexer to provide a simplified form of V.O.R. reception. Radial determination is by coarse adjustment of a dial and fine adjustment of a vernier tuner in conjunction with a "left-right" needle. "To-from" sensing is by observation of the blue-yellow movement as on a standard I.L.S. meter. The Omniplexer costs $195 (about £68) in the United States.

CROP SPRAYING IN SPAIN

TWO companies in Spain are engaged in fairly extensive crop and forest spraying. Operations began last year after the government had awarded contracts to two firms, Servicios Agricolas Aereas, S.A., and Aerotecnica, S.A., in 1952. Main targets were pests in oak, pine, olive and cotton, and crops infested by locusts. Altogether 55,000 hectares were treated, most of them government property. This year, however, the results have become known to many large land-owners, and already some 82,000 hectares have been sprayed; it is estimated that 25,000 hectares of cotton will be included later this year. (One hectare is 2.47 acres.)

Spain, with its large fields, poor roads and considerable distances between towns, is considered ideal territory for crop-spraying. The average height of terrain is 3,000ft. The two companies employ mostly African pilots and Servicios Agricolas operates ten Wasp-Junior-engined Stearmans carrying 1,650 lb, while Aerotecnica has sixteen 135 h.p. and 150 h.p. Piper Cubs, carrying 660 lb each. These spraying operations are said to be on a larger scale than anywhere else in Western Europe.

THE VETERAN STRATOLINERS

A Remarkable Record of Commercial and Military Service

By DENNIS M. POWELL, F.R.G.S.

WHEN the sale of Trans World Airlines' five Boeing 307B Stratoliners to the French independent operator, Aigle Azur, was announced—in April 1951—a new chapter began in the already colourful career of these remarkably interesting transport aircraft.

The five were all delivered to Aigle Azur between May and August 1951, being ferried by French and American crews from T.W.A.'s base at Kansas City to Marignane (Paris) *via* Boston, Gander, Keflavik and Prestwick. For the record, they were originally registered NC.1940 to NC.1944, whilst their war-time U.S.A.A.F. serials were 288627, 288628, 288629, 288300 and 288301 respectively: they were then given the designation C-75. Each aircraft was named by the U.S.A.A.F. after a famous Red Indian tribe—*Navajo, Apache, Zuni, Cherokee,* and *Comanche.* The five aircraft bear constructors' serial numbers 1998, 1996, 1999, 2000 and 2001 respectively.

The five Stratoliners together with additional engines and considerable quantities of spares were sold to Aigle Azur for some $550,000, a most reasonable figure considering that T.W.A. had spent almost $2,000,000 in having them practically re-built in late 1944. Furthermore, there were still ample B-17 Fortress spares available from the U.S. War Surplus Disposals Board.

The basic design of the Boeing 307 goes as far back as mid 1936, when the president of T.W.A., Jack Frye (himself an airline pilot of wide experience) and his technical advisers got together with Clair Egtvedt, Boeing's chief designer and his team to agree on a specification for a four-engined, 33-passenger airliner. It was to be capable of operating at 20,000ft-plus with pressurized crew and passenger cabins; to cruise at over 220 m.p.h.; and to have an a.u.w. of approximately 45,000 lb. At the same time, the technical projects branch of Pan American Airways also worked in close co-operation with Boeing and T.W.A., because P.A.A.'s president, Juan Trippe, was seeking a four-engined landplane replacement for the old Consolidated Commodore flying-boats which were then still operating on his New York/Rio de Janeiro/Buenos Aires schedules.

The original prototype Stratoliner, NX.19901, first flew on December 31st, 1938, with the late "Eddie" Allen (Boeing's chief test pilot) at the controls. Since it incorporated a considerable number of technical advances in the field of large-airliner construction (particularly the then unproven and intricate mechanism for the pressurization of the complete fuselage) there were inevitably major technical problems to be overcome. In the following March there was a tragic setback, when the aircraft crashed with a K.L.M. technical mission aboard. It is believed that the cause was failure of both wing-tips when the design-load was greatly exceeded during pull-out after a test stall.

Boeings nevertheless continued with intensive development, and a second prototype, NX.19905, flew in August 1939. It incorporated a considerable number of modifications, which included a complete re-design of the tail unit. Happily, the intensive test period of six months that followed this work was completely successful and the Stratoliner was subsequently awarded its Certificate of Airworthiness by the C.A.A.

The first three production Stratoliners were delivered to Pan American Airways early in 1940 (registered NC.19903, 19904 and 19905) and were put into service on York/Rio/Buenos Aires schedules in April of that year. When America came into the war after Japanese attack on Pearl Harbour, the trio were impressed into service with U.S.A.A.F. Air Transport Command, which was formed in early 1942. Flown by P.A.A. crews the three Stratoliners operated military schedules between the U.S.A. and South America until late 1944, when they were demobilized and handed back to P.A.A.

SINCE this article was written—the author lives abroad—Aigle Azur's Stratoliners have, in effect, changed hands yet again, for Union Aéromaritime de Transport, the French overseas operators, have acquired an interest in the company. We believe that two or three of the quintet have new registrations, and at least one has been repainted in U.A.T. colours.

T.W.A.'s five Stratoliners (Model SA-307-3) were delivered to that airline shortly after Pan American's three, and from July 1940 to December 24th, 1941, were employed on the famous "coast-to-coast" trans-U.S.A. schedules. Then America's only four-engined landplane transports in regular service, and cruising at 220 m.p.h., they reduced the transcontinental schedules from 18½ to 14½ hours. They flew a grand total of about 4,500,000 passenger-miles without accident, and carried 109,000 passengers. They were then "called to the colours" with Air Transport Command. Stripped of all luxury passenger fittings, and fitted with fuselage tanks carrying an additional 750 U.S. gallons of fuel, these long-range landplane transports (of which so very few types were flying back in 1942) were painted in drab green olive and brown paint, and named after famous Red Indian tribes as already stated above.

During the following 2½ years of military service T.W.A.'s Boeings flew almost 3½ million miles without accident: these included a total of 762 flights over the North and South Atlantic, during which they visited every Continent except Australasia. On these and other flights overseas they carried considerable quantities of vital war cargoes, amongst which were top-priority supplies of armour-piercing ammunition, flown from American factories to Egypt for General Montgomery's coming 8th Army offensive against Rommel's Afrika Corps. Amongst the large number of war-time V.I.P.s who travelled in these aircraft were President Roosevelt, Queen Wilhelmina, President Vargas of Brazil, General George Marshall, Madame Chiang-Kai-Shek and General Giraud.

The Boeings' war-time duties also included the training of U.S.A.A.F. crews in the art of celestial and dead-reckoning navigation until other types of long-range aircraft became available. Then—in August 1944—these aircraft were "demobbed" and returned to their owners.

T.W.A. decided to have each aircraft rebuilt and completely "modernized" at the Boeing factory. To improve payload characteristics (and because of the enormous immediate post-war traffic demands, coupled with the shortage of large four-engined transports—a small number of DC-4 Skymasters were only just beginning to reach a few U.S. airlines) the pressurization equipment was removed, whilst passenger seating was increased from 33 to 38. Improved structural alterations included the fitting of B-17G Fortress-type wings, landing gear and tail assembly, and the more powerful Wright Cyclone Series GR-1820-G205A engines were fitted, giving better performance. The virtual rebuilding of each of these aircraft cost T.W.A. $285,000 per unit, but good dividends to the airline subsequently resulted, because these Stratoliners were still virtually the only four-engined landplanes in commercial service in the U.S.A. until considerable numbers of DC-4s became available after V.E. Day, to be followed much later by Constellations and DC-6s.

The ninth and last Boeing 307 built was sold to millionaire Howard Hughes, who used it in conjunction with his Company, Hughes Aircraft, Inc. This particular Stratoliner (NC.19902) was known as the Model SB-307B, and was luxuriously fitted out with sleeping bunks, "conference room" and other special interior features associated with executive transports. Hughes sold this aircraft in 1948 to another millionaire, Glenn McCarthy, of Texas. In 1950 it was sold to a third millionaire, a Mexican. One of P.A.A.'s Boeings went to the *Corps d'Aviation de l'Armée* in Haiti where, to the best of my knowledge, it is still giving sterling service. The others have changed hands twice since they were sold by that airline. I understand they are currently being operated by Aerovias Ecuatorianas C.A. of Ecuador, who fly them between Guayaquil and Miami. As non-I.A.T.A. carriers,

The first prototype, NX 19901, which flew on December 31st, 1938. Stratoliners were the first pressurized airliners.

January 1945: the first of T.W.A.'s five rebuilt Stratoliners (still bearing its original U.S.A.F. serial number and military insignia) takes off on a test flight at Seattle.

they charge the cheapest fare between these two cities—$150 against the standard I.A.T.A. tourist fare of $187.

It is apparent that the small number of Stratoliners built have, even now, several years of useful service ahead of them. Their history suggests that the useful life of a modern transport aeroplane is quite often in excess of the figure of seven to ten years often quoted nowadays.

At the time of writing, Aigle Azur's five are flying on the twice weekly Paris-Saigon schedules, covering the 12,560 km in 40½ hours' flying time, with night-stops at Beyrouth, Karachi and Calcutta. They also operate special charter flights between France and Madagascar; the writer saw one of them at Mombasa in January 1954; it was *en route* from Tananarive to Paris. Although I cannot, unfortunately, quote precise airframe hours for these French-owned Stratoliners, I understand from reliable sources that each of them has logged some 30,000 hours in its lifetime of 14½ years. Quite a remarkable achievement!

Loading data for Boeing Stratoliner SA-307-B: Four Wright GR-1820 Cyclone-engines, 1,200 h.p. each; 38-passenger, long-range, transport; wing span 107ft 3in; length overall 74ft 4in; height overall, 20ft 9.38in; empty weight, 30,310 lb; gross weight, 42,000 lb; top speed, 246 m.p.h.; cruising speed, 210 m.p.h.; maximum range, 2,390 miles; service ceiling, 26,200ft; wing loading, 28.3 lb/sq ft; power loading, 9.6 lb/h.p.; fuel capacity, 1,700 U.S. gal.

THE AERONAUTICAL BOOKSHELF

"Jump For It" by Gerald Bowman. Evans Brothers, Ltd., Montague House, Russell Square, London, W.C.1. Illustrated. Price 12s 6d.

IN ideal conditions, parachuting requires nerve and a modicum of luck; and seldom does anything go seriously amiss in the process. If a premeditated jump is properly carried out, the main pre-requisite is nerve. In an emergency escape from what Mr. Bowman calls a doomed aircraft, the situation is to a considerable extent reversed. Under the stimulus of fire or structural failure, the nerve is rarely if ever lacking, but the calm conditions of practice are only too conspicuous by their absence. Anything may happen, and the theme of *Jump For It* is that practically everything, in fifty years of flying, has happened. The would-be escapee can be dragged behind his plunging aircraft by his intercom lead, set alight by the flames from it, unable to extricate himself from the fuselage, or simply deposited on the unyielding bosom of mother earth in some impossibly complicated position. Some pilots, Lindbergh among them, have been hounded, during their descent, by the aircraft they have just abandoned.

With a brief history of the development of the parachute by way of introduction, Mr. Bowman (a squadron leader during World War 2 and a pilot), sets out the experiences of some of the members of the Caterpillar Club who had a rather rougher time than others. In the face of some first-class factual story-telling one has to forgive him a slight over-emphasis of the "true-blue" qualities which make many war-films stick in one's throat. *Jump For It* is a fine record of some of the parachute escapes which have been made and includes what must be the first full published account of an emergency ejection from Sabres. If the writer could have had access to some of the accident summaries produced, but not released, at about the same time he would have had much worthy material. Even so, the book stands as another facet of the many-sided history of aviation.

"Aviation English" by S. Humbert. Dunod, Editeur, 92 Rue Bonaparte, Paris 16e. In two volumes, price 850 francs (approx. 17s 6d) each.

THESE two small volumes are intended to enable a Frenchman to learn English up to the standard required by the NATO and other international organizations, for normal radio and spoken communications. The first part extends to the official elementary certificate standard and the second to that for radio operators. M. Humbert is professor of English at the Centre d'Enseignement Supérieur Aérien and president of the Anglo-French Institute, and he also teaches at the French Air Staff College and School of Air Warfare; he is therefore well qualified in his subject.

The two volumes are divided respectively into 75 and 100 lessons, each complete with vocabulary and exercises, with correct answers in appendices; and particular care has been taken to inculcate correct pronunciation and sound basic grammar right from the start. Only in the second volume does M. Humbert deal with exceptions and complications.

OF a considerable number of papers recently delivered before Italy's *Centro per lo Sviluppo dei Trasporti Aerei* (Society for the Development of Air Transport), several will be of interest to air transport operators and authorities in other countries. They are available as reprints on application to the *Centro* at 18, Piazza Grazioli, Rome. All are in Italian. Brief summaries follow:—

Air Insurance (*L'Assicurazione Aeronautica*), by Prof. Dott. Bruno De Mori, president of the Italian Air Insurance Confederation.—A discussion of the technical features of air risks considered as a series of events relating to persons, things and responsibilities, with particular emphasis on the importance of statistics.

Relationship of Air and Surface Travel (*Rapporti tra Linee Marittime e Linee Aeree*), by Dott. Francesco Manzitti, president of the marine finance company FINMARE.—The author deals with the relative potentialities of the two forms of transport and gives, in an appendix, a series of comparative traffic statistics.

The Planning of Transport Economy and the Politics of Air Transport (*Pianificazione di Economia dei Trasporti e Politica dei Trasporti Aerei*), by Prof. Avv. Renato Trevisani, director of the Institute of Applied Economics of the University of Trieste.—The author deals with the situation in Italy where, after the war, plans for civil aviation were not included in those for economic revival. He sets out the conditions which apply in this particular sphere in re-establishing air transport alongside other forms of transport.

Flight Information and the Safety of Air Navigation in Europe (*L'Assistenza al Volo e la Sicurezza della Navigazione Aerea in Europa*), by Dott. Publio Magini, director of Decca Navigator Italiana.—Dr. Magini analyses the various navigation aids available at present and appeals for rational, standardized equipment suitable for all altitudes and giving accurate coverage, on the lines of the Decca system.

OTHER BOOKS RECEIVED

High-speed Aerodynamics and Jet Propulsion, Vol. VI: General Theory of High-speed Aerodynamics, edited by W. R. Sears. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 100s.

High-speed Aerodynamics and Jet Propulsion, Vol. IX: Physical Measurements in Gas Dynamics and Combustion, edited by R. W. Ladenburg, B. Lewis, R. N. Pease and H. S. Taylor. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 84s.

Highway to the North, by Frank Illingworth. Ernest Benn, Ltd., Bouverie House, Fleet Street, London, E.C.4. Price 25s.

The Jet Aircraft of the World, by William Green and Roy Cross. Macdonald and Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 30s.

Le Droit Aerien, by R. Saint-Alary. Librairie Armand Colin, 103 Boulevard Saint-Michel, Paris.

The Hydrogen Bomb, by James Shepley and Clay Blair, Jr. Jarrolds Publishers (London), Ltd., 11 Stratford Place, London, W.1. Price 12s 6d.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Habbaniya Memories

I WAS greatly interested in the article in your issue of June 3rd, regarding the handing-over of the R.A.F. station at Habbaniya to the Iraqi Government. The mention of No. 70 Squadron recalls that unit's very useful work whilst at Hinaidi. I was a member of the squadron from March 1928 until November 1931. It was in the early part of 1930 that officials from the Air Ministry arrived at Hinaidi, and two Victorias of No. 70 Squadron carried them to Lake Habbaniya. Whilst these officials surveyed the site the two crews had a great time in the lake itself.

Whilst at Hinaidi we saw the start of the Iraqi Air Force, and the photograph [in col. 2—Ed.] shows their first aircraft.

W/C. Blount was our C.O. when I left the unit, and another photograph [not quite clear enough for reproduction—Ed.] shows him and his passenger, Sheikh Mahmud, on arrival at Hinaidi after the said passenger's surrender. This was after continual raids on the tribesmen by the Iraqi Levies, after harassing by Nos. 70 and 55 Squadrons.

I have no doubt many other ex-70 Squadron members recall these memories.

Darlington, Co. Durham. JOHN T. BENNETT.

Gipsy Moths of No. 1 Sqn., Royal Iraqi Air Force, flying over the cantonment at Hinaidi; in the background is the River Tigris. (See letter from Mr. John T. Bennett.)

Industrial Target?

CAN anyone tell—short of actually trying it out—what would be the result of a supersonic bang, or a cannonade or *feu de joie* of them, striking the exhibition marquee at Farnborough fair and square during the S.B.A.C. Show?

London, S.W.3. GEOFFREY DORMAN.

A. V. Roe Ingenuity

MAY I confirm Mr. T. Jones' remarks [June 17th] about Sir Alliott Verdon Roe's two-wheeled motor vehicle? When I was visiting his works in 1922 (or 1923) Sir Alliott showed me the vehicle and demonstrated its ease of handling and stability by driving round a quite appreciable bend in the road with his hands above his head.

As far as I can recollect, the vehicle could scarcely be described as a protective body fitted to a motor cycle. The c.g. was lower and the design was much more like that of the modern small-wheeled motor cycle, the main difference being that his vehicle had considerably more side protection than the modern version.

I formed the opinion—and I still hold it—that the vehicle was as near an approach as possible to a two-wheeled car as one could hope to attain and that there would be an appreciable market for such a single-seater for such work at the daily journey to and from the office without the need for special clothing.

Farnham, Surrey. A. F. CRESSALL.

The Fairey IIID referred to by Mr. J. Arnold. Refuelling methods of 21 years ago make an interesting study.

King's Cup Seaplane

FOLLOWING your publication [July 22nd] of the 40-year history of the Fairey Company, I believe I am right in saying that the Fairey IIID had the distinction of being the only seaplane ever to take part in the King's Cup Races. One F.A.A. machine, serial number N9777, was entered in the 1924 King's Cup Race, flown by Capt. Norman MacMillan. It came second.

Hassocks, Sussex. J. ARNOLD.

[Our correspondent's recollection is accurate. We reproduce here a 1924 photograph of the aircraft.—Ed.]

FORTHCOMING EVENTS

Aug. 6-7. Dieppe Air Rally.
Aug. 13-18. Fourth Air Tour of Switzerland.
Aug. 15-26. Commonwealth Survey Officers' Conference, Cambridge.
Aug. 17-27. Model Engineer Exhibition, New Horticultural Hall, London.
Aug. 19-20. R.Ae.C.: Fourth National Air Races Meeting, including King's Cup Race and Lockheed Aerobatic Trophy Competition, Coventry.
Aug. 21. Northamptonshire Aero Club; At Home.
Aug. 27. Aircraft Golfing Society: Founders' Cup, Stoke Poges.
Aug. 27. R.N.A.S. Anthorn, Cumberland: Air Day.
Aug. 29-Sept. 4. Riviéra dei Fiori Aero Club: Rally and "Caravance Riviéra des Fleurs."
Sept. 3. Leicestershire Aero Club: Air Display.
Sept. 3-5. U.S. National Aircraft Show, Philadelphia.
Sept. 5-11. S.B.A.C. Show, Farnborough (Public Days, 9th, 10th and 11th).
Sept. 8. Helicopter Association: Annual Dinner; and Lecture—"Design, Development, Production and Servicing of Rotor Blades," by R. Allen Price.
Sept. 12-18. Battle of Britain Week.
Sept. 19-23. Institute of Metals: Annual Meeting, Buxton.
Sept. 23. Yorkshire Aeroplane Club: Annual Ball, Harrogate.
Sept. 24. Aircraft Golfing Society: Brown Bros. (Aircraft) Trophy.
Oct. 7. Helicopter Association: "The Control of Helicopter Rotor Vibration," by P. R. Payne.
Nov. 11. Helicopter Association: "Design of Helicopter Operating Sites," by H. T. Hough, M.I.C.E., M.I.Mun.E., M.T.P.I.
Dec. 16. London Airport inauguration by H.M. the Queen.

CF-100's in formation on winter patrol over Canada's Northern approaches.

. . . in England now

Three CF-100 all-weather interceptors recently flew the Atlantic and are now on evaluation tests with the R.A.F. in England.

In that swift crossing, Avro Aircraft reversed the trend of aeronautical development to place at the disposal of the R.A.F. the world's outstanding all-weather interceptor.

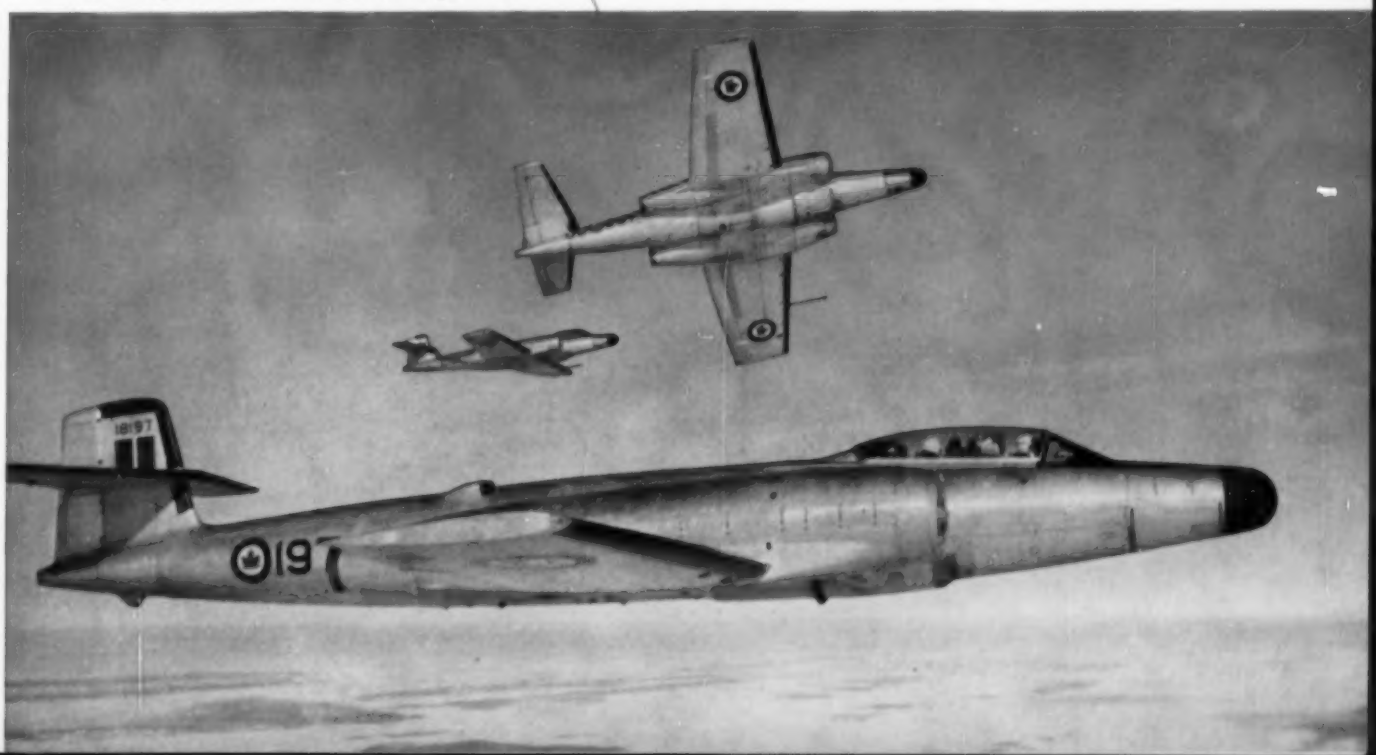
Additional evidence of the serviceability and performance of the CF-100 is its unanimous selection to equip by 1956, four R.C.A.F. squadrons to strengthen the all-weather defence capabilities of NATO in Western Europe.

Avro Aircraft, as one of the main industrial arms of the R.C.A.F., is constantly at work reinforcing and maintaining the air defence of the free world.

AVRO AIRCRAFT LIMITED MALTON, CANADA

A. V. ROE CANADA LTD.—MEMBER, HAWKER SIDDELEY GROUP

Three CF-100's flew the Atlantic in March and four R.C.A.F. squadrons will be on duty over Europe in 1956.



Instantly and accurately the link between the various pieces of vital electronic and electrical equipment aboard the modern aircraft—Plessey Mk. 4 plugs and sockets make light work of their highly complex function. On the maintenance side, they cut the time and cost of routine testing and equipment servicing to a minimum: functionally they form the most precise and lastingly efficient union of their type. And in addition, to meet the demands of the aircraft industry, Mk. 4 plugs and sockets are pressure proof at 20 pounds per square inch. The current range is designed to meet the operating conditions laid down in R.C.S. 321.

*

To take care of increasing problems in aircraft of the future the Company is continuously and extensively engaged in research and development.

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CIVIL AVIATION

CAPITAL VISCOUNTS AT WORK

AS intimated in *Flight* last week, the first Viscount service inside the U.S.A. began on July 26th, on Capital Airlines' Washington-Chicago route. Three Viscounts (60 have been ordered) are scheduled to make three round trips daily between the two cities.

The first machine took off from Washington National Airport at 8.30 a.m. on July 26th with a full load of 44 passengers, one of whom was Mr. J. H. Carmichael, the president of Capital. Before the Viscount taxied out, the presidents of six U.S. Chambers of Commerce cut individual ribbons attached to the tail of the aircraft. Formal ceremonies also took place at Chicago to mark the departure on the east-bound run. Some passengers on these inaugural flights had booked seats over a year ago.

Capital's Viscount services have been introduced with appropriate publicity. Hoardings in Chicago proclaim a "new era in flight," and the *Chicago Daily News*, whose travel editor was taken on a preview trip, printed this banner headline: "Flying in the Viscount is like sailing on a cloud."

Capital now have three of their Viscounts, and the delivery of the remaining 57 will begin in September. Eventually all Capital's network, which serves over 70 cities, will be maintained with Viscounts.

At a ribbon-cutting ceremony on the occasion of the first Capital Airlines Viscount flight, recorded on this page, are (l. to r.): Ralph W. Powers, president of Prince George's County (Maryland) Chamber of Commerce; J. H. Carmichael, president of Capital Airlines; and J. S. Everly, president of Alexandria (Virginia) Chamber of Commerce.

VISCOUNT REGAINS RECORD

THE Perth-Adelaide record previously wrested from T.A.A. by A.N.A.'s DC-6 was regained by the former company on July 26th when VH-TVE covered the 1,415 miles in 3 hr 16 min at a ground speed of 425 m.p.h. The tailwind component was 105 m.p.h. and the altitude 27,000ft. This brings the Viscount tally of Australian domestic records to ten in about seven months of operation.

SOUTH BANK BUSINESS SLOW

THE South Bank-London Airport helicopter service by B.E.A., inaugurated on July 25th, has been getting off to a slow start. On July 28th two trips were made with no passengers and three with only one. On all eight outgoing trips, however, full loads (of sightseers) were carried. It is considered that the lack of demand on the inward run was due to air travellers being unaware of the facility, and the fact that they could not book in advance. Half the seats are now bookable.

L.A.P.'s No. 1 RUNWAY

HITHERTO closed to traffic between 10 p.m. and 7 a.m., following complaints by local residents, the No. 1 runway at London Airport is to be fully used in September, when the parallel runway, formerly used as a substitute during the banned hours, will be closed for repair. A spokesman for the Cranford Residents' Association has said that, although the Minister had given an assurance that No. 1 was not to be used except in emergency, the airport authorities had allowed take-offs and landings freely. Much damage, he said, had been done and children were frightened.

STRATOCRUISER VIBRATION INDICATORS

THE 16 Boeing Stratocruisers owned by B.O.A.C. are now being fitted with vibration indicators, following the lead of the American operators, on orders from the C.A.A. A C.A.A. spokesman said that this action had been taken as the result of a series of accidents involving Stratocruisers, all operators of which had been urged to replace hollow-steel airscrew blades (which had a tendency to crack and set up vibrations) with solid aluminium blades. Vibration indicators would serve as an interim measure.

CONSTELLATION SHOT DOWN

A LOCKHEED Constellation of El Al Israel Airlines, *en route* from London to Israel, was shot down by Bulgarian anti-aircraft fire on the Greek-Bulgarian border on July 27th, with the loss of 58 lives. A communique issued by the airline on the same day ran: "At 0837 Israel time today an S.O.S. message was received by El Al operations from El Al Constellation 4X-AKC, which was flying from Vienna to Lod and was close to the Greek-Bulgarian border. A little later a message was received from Athens airfield that the aircraft made a forced landing near Sirvanovo, Bulgaria, near the Greek border, after it had been shot at."

A communique issued by the Bulgarian Telegraph Agency in Sofia on July 28th said that the machine "departed from its route and entered Bulgarian air space in the area of the town of Tarn without warning." The statement continued: "It flew over the town of Stanke Dimitrov, the town of Blagoevgrad, and southward to the town of Petrich. The anti-aircraft defences were unable to identify the plane and after a few warnings opened fire, as a result of which the plane crashed in the area north of the town of Petrich. All passengers and crew perished. The Bulgarian Telegraph Agency has been authorized to express the deep regret of the Bulgarian Government and of the entire Bulgarian people for this disaster."

On July 30th a three-man Israel investigation team was permitted a short visit to the scene of the crash. They reported finding bullet holes in parts of the wreckage (unofficial reports had earlier suggested that the Constellation was fired on by one or more Bulgarian jet fighters), and said that Bulgarian officials afforded little assistance or co-operation. Strong protests have been made to the Bulgarian Government by Britain, France, Israel and the United States.

B.E.A. CAR-HIRE SCHEME

MOTORISTS who, visiting the Continent, make the crossing by B.E.A., will be able to hire a self-drive car without paying a deposit or, as a rule, spending their foreign currency on the hire fee, under a new scheme to be introduced by the Corporation on September 1st.

The facility will be available initially in ten countries, where B.E.A. has reached agreement with hire contractors controlling over 3,000 cars. At the same time, car-hire facilities will be introduced at cities served by B.E.A. domestic flights. The hire charge may be pre-paid in sterling, as long as it does not exceed £35, when the extra must be settled locally with the contractor in his currency. There will be no delivery or collection charges at airports, air terminals or hotels in the vicinity. The scheme will be available at first in Belgium, Cyprus, Denmark, France, Germany, Holland, Italy, Norway, Sweden and Switzerland. Typical costs are given by B.E.A. as follows:—

Example.—Hirer requires Volkswagen Standard delivered in Dusseldorf for a period of 10 days, involving an anticipated journey of 1,000 km. Passenger is flying out London-Dusseldorf and back Brussels-London. Car to be collected from Brussels.

(i) 10 days at basic rate (inclusive of 80 km daily)		= £20	5 0
(ii) Additional km = Total anticipated ... 1000			
less km included in basic rate, i.e., 10 × 80 800			
Additional km at 4d/km ... ... 200 km			
(iii) Cost of collection from Brussels	=	5 11	0
Total anticipated cost	= £29	2	8

HERONS ON INDIAN ROUTES

THE Indian Airlines Corporation have been encouraged by the initial response to the domestic feeder service inaugurated with D.H. Herons between Delhi and Bombay in May this year, and have plans for utilizing fully their eventual fleet of eight Herons. Five Herons have already been received and these will operate on new services this month. Average load factor for the first month of Heron operation was 69 per cent. Plans for the fuller utilization of Herons include a circular service in each direction, originating and ending in Madras, with halts at Bangalore, Coimbatore, Cochin, Trivandrum, Madura and Tirichirapalli. The Delhi-Bombay service, *via* Agra, Gwalior, Bhopal, Indore and Aurangabad, will be operated daily. This line especially is

CIVIL AVIATION . . .

expected to attract more freight (particularly in mail and newspapers) and, with the onset of the tourist season, more passengers. The Heron now used on a thrice-weekly service between Delhi and Lahore will also be utilized for a service betweeen Delhi and Rajkot *via* Bikaner, Jodhpur and Ahmedabad on the alternate three days.

STATE "PERSUASION"

THE chairman of America's Civil Aeronautics Board, Mr. Ross Rizley, stated recently that the State Department "persuaded the Board to give Lufthansa the right to compete with American airlines in transatlantic Latin-American business." State Department officials told him, he says, that a more liberal policy on new German requests would be necessary to support America's foreign policy objectives, and such strong representations were made that the Board felt "maybe we should be more liberal." An agreement giving Lufthansa rights to compete with American airlines in return for American rights to fly in Germany was signed on July 7th, despite protests from most major American operators.

NEW SERVICES APPROVED

THE M.T.C.A. announce Ministerial approval, after considering the recommendations of the Air Transport Advisory Council, for operation of the following services during 1955:

Eagle Aviation, Ltd.—An internal service between London and Jersey until August 6th.

Dan-Air Services, Ltd.—An inclusive-tour service between London (Blackbushe) and Calvi (Corsica) until September 25th.

Lancashire Aircraft Corporation, Ltd.—An inclusive tour service between Blackpool (Squires Gate) and Beauvais (Tille) (or Corneille-en-Vexin (Pontoise) until August 15th) until October 5th.

The Minister has also approved the following application for an amendment to an air service:—

B.K.S. Air Transport, Ltd.—The inclusion of an optional traffic stop at Leeds (Yeadon) and a Customs stop at Southend on their inclusive-tour service between Newcastle and Basle.

KANGAROO CALL AT PERTH

FROM August 10th Qantas Empire Airways are introducing a further variation in their Sydney-London Kangaroo route by calling twice a week at Perth, Western Australia. The alternative routes then offered will be: Sydney-Singapore, *via* Darwin and Jakarta or Perth and Jakarta; Singapore-Karachi *via* Calcutta, Bangkok and Calcutta or Colombo and Bombay; Karachi-London, *via* Cairo and Rome or Beirut, Rome and Frankfurt. Extension of the Kangaroo service to Perth will give Western Australia a direct link with South Asia, the Middle East and Europe, and with South Africa.

AUSTRALIAN CIVIL HELICOPTER

IT is proposed by Australian National Airways and the Molyneux Company to operate helicopter services, based on Melbourne and Sydney, in late 1955 and early 1956. A.N.A. will use a Bristol Sycamore (mainly for experimental and charter work), and the Molyneux Company plan to operate an S-55 out of Melbourne and Sydney on scheduled passenger flights. Australia's Department of Civil Aviation has almost completed the framing of regulations for the operation of these services.

It is further reported from Australia that Mr. G. C. Molyneux is developing a helicopter of his own design, with "a new type of rotor head."

PANAM AND SIAM

SIAM is expected to sign an agreement in Washington shortly whereby Pan American World Airways would assist in expanding and improving Siam's commercial airline, Thai Airways Co., Ltd. It is reported from Washington that under the terms of the agreement PanAm would place 24 experts at the service of the Siamese Government to work together with 24 Siamese officials. Advice would be given on the improving of airfields, the handling of cargo and passengers, and the maintaining of schedules. Siam would pay for this service "with counterpart funds released by the U.S. International Co-operation Administration Aid Program in Siam," and PanAm would have no financial interests in the Siamese airline.

BREVITIES

A NEW record for airline traffic is claimed by American Airlines for June, in which month the company flew more than 686,000 passengers approximately 416 million passenger miles. This was the first month in the history of commercial aviation that any airline has flown more than 400 million passenger miles.

* * *

In 1954 civil aircraft in New Zealand flew just on 94 million passenger miles and carried more than 66 million pounds of freight and mail. Additionally, more than 279,000 tons of top-dressing materials were distributed, involving over a million flights and the treatment of 2¼ million acres.

* * *

A plan to spend more than 50 million marks (about £4,200,000 sterling) on Düsseldorf Airport will make it the biggest in Europe by 1970. Making this announcement last week-end, the North Rhine-Westphalian Economics Minister, Dr. Friedrich Middlehauve, claimed that when the plan was completed the airport would be able to handle 5,000 passengers an hour.

* * *

First Pakistani pilots to receive command appointments with Pakistan International Airlines are Capt. D. P. David and Capt. Chaukat Husain, both of whom have more than 6,000 hr in their log books. The two new captains, who have previously flown as co-pilots on the airline's international and domestic services, will command Super Constellations on the Karachi-Dacca route.

* * *

In a recent speech on Soviet civil aviation, Marshal Zharvoronkov, head of Aeroflot, said that Russian agricultural aircraft had been engaged on pest-control work in Persia, Czechoslovakia and Hungary. A particularly large air expedition, he added, had recently been sent to China at the request of the People's Government to assist in agricultural duties.

* * *

The construction of a new 6,600ft runway at Benina Airport, Benghazi, is now nearing completion. For the last two years the airport has been restricted to aircraft not exceeding 40,000 lb a.u.w. (with the exception of B.E.A. Elizabethans); when the new runway is completed, however, Benina will become an I.C.A.O. Category "D" airport. The width of the runway, which is being constructed parallel to the existing runway, is 150ft, and 60ft-wide taxiways are being incorporated. At present the airport is open ten hours daily; an increase to 24 hr operation, following completion of the runway in September, is anticipated.

* * *

The Amsterdam-Rome-Athens service of K.L.M. has been extended to Tel Aviv, Israel. From Athens to Tel Aviv the service will be maintained by El Al Israel Airlines with Convairs chartered from K.L.M. The Dutch company are already operating two weekly services from Amsterdam to Tel Aviv, one *via* Rome and the other *via* Munich.

* * *

A 39 per cent increase for the first six months of this year in the amount of cargo flown between the U.S.A. and Europe is announced by Pan American. During June the airline flew 2,958,000 lb over the Atlantic, against 2,126,000 lb for the same period last year. Four freight flights are now operated per week in each direction—more than by any other carrier.

* * *

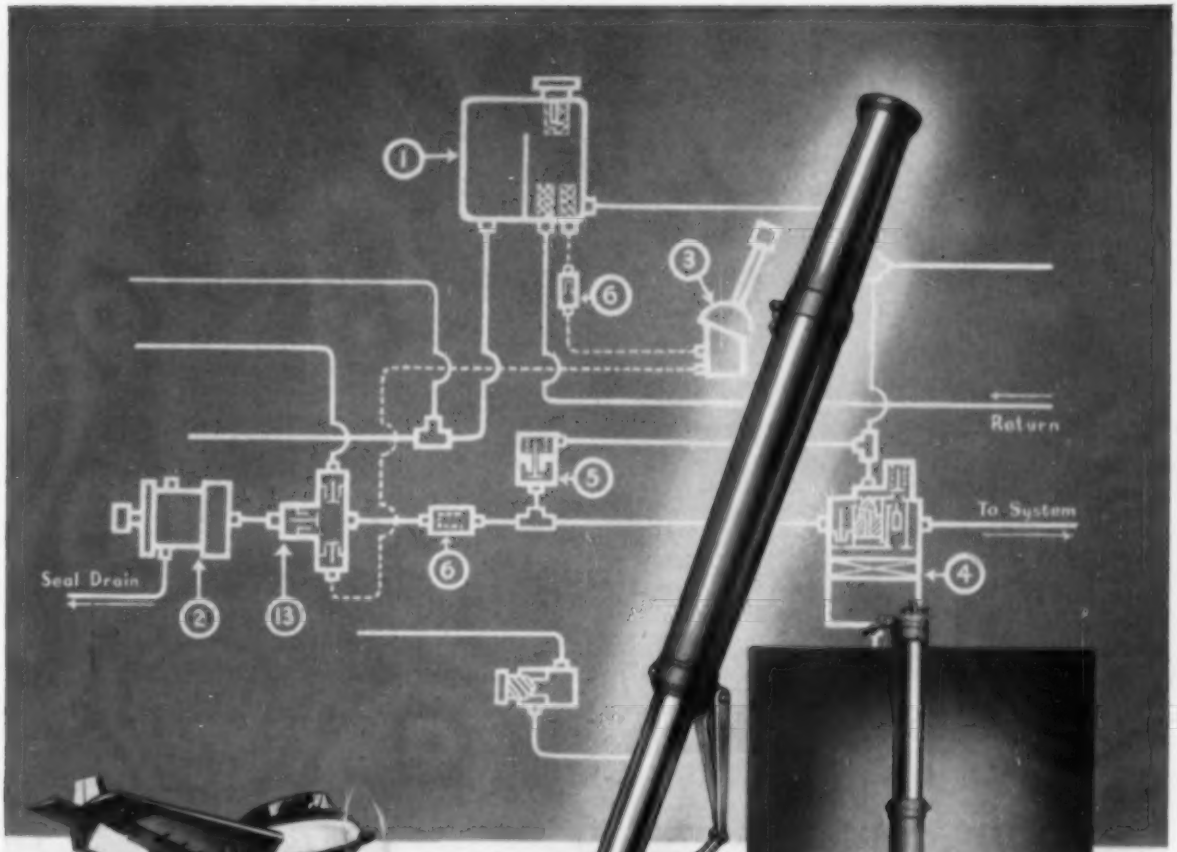
Four new luxury coaches have been introduced by K.L.M. for the transportation of passengers between the Sloane Street terminal and London Airport. They will replace smaller coaches, which have been in use since 1948, and although 38 passengers could be accommodated, capacity has been reduced to 30 seats to provide extra comfort.

* * *

International Aeradio, Ltd., have contracted to provide to the Government of Singapore, Department of Civil Aviation, two air traffic control officers for duty at Kallang Airport, Singapore. The provision of experienced staff for long or short tours of duty to assist in air traffic control, communications, airport management, fire services, briefing and aviation meteorology is one feature of I.A.L.'s service.

* * *

Within about ten months Lufthansa intends to provide refresher courses for 136 pilots, some of them formerly with Lufthansa and others ex-members of the Luftwaffe. At present 81 pilots are undergoing refresher courses, of whom 44 wish to obtain co-pilots' certificates for Convairs. At the end of this year Lufthansa hopes to be able to start training pilots *ab initio*.



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Aero Engine Test Equipment

MOBILE

Illustration showing "J" type Mobile test stand with sound-proof control cabin.

"W" TYPE TEST STAND
For the testing of in-line radial piston engines up to 4,000 horse power.

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For the testing of Turbine propeller engines up to 5,000 horse power.

"J" TYPE TEST STAND
For Turbo-jet engines up to 15,000 lb. thrust.

"B" TYPE TEST STAND
For in-line and radial piston engines up to 600 horse power.

JOHN CURRAN

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

H.R.H. Prince Bernhard of the Netherlands, whose honorary promotion is referred to here, inspects the cadets at the passing out of No. 65 Entry from Cranwell on July 26th.

Prince Bernhard Promoted

THE Queen has been graciously pleased to approve the promotion of Prince Bernhard of the Netherlands to the honorary rank of air vice-marshal in the R.A.F.V.R.

In his new rank he was reviewing officer at the passing-out parade of No. 65 Entry at the R.A.F. College, Cranwell, on July 26th. He presented the sword of honour to Sen. U/Off. T. R. Morgan.

In his address, Prince Bernhard—who is a pilot of considerable experience—stressed the danger and folly of low flying and showing off in jet aircraft. A really efficient air force, he said, required a rigid flying discipline based on self-discipline.

Brawdy's Air Day

RIVALLING Ford's programme on the same day R.N.A.S. Brawdy gave an air display for 10,000 spectators on July 23rd which included aerobatics by such widely assorted aircraft as an Olympia, a Chipmunk, a Provost, a Hunter, three Vampires and a Meteor 7.

Helicopters opened the display by towing welcoming banners over the crowd and were followed soon afterwards by four Shackletons from St. Eval flying past on four, three, two and one engine respectively. Four Sunderlands later also flew past, feathering and unfeathering various of their airscrews.

Aerobatics by the Hunter (from Chivenor) contrasted with an air drill demonstration by Gannets and a rocket-assisted take-off by Fireflies of No. 1831 Sqn. R.N.V.R. At this juncture Lt-Cdr. Crofts showed the Olympia's silent paces.

The Provost hailed from Ternhill and was flown by F/L. Curry; and one of the manœuvres performed by Mr. Bell, Airwork instructor, in the Meteor 7, was an upward bunt from 100ft. F/O. Goadby, from Chivenor, made half a bunt downward out of a tail-slide in the Chipmunk.

Formation aerobatics in three Vampires from No. 502 Sqn., R.Aux.A.F., based at Filton, were led by F/L. Wingate just after Capt. Rayner had made a parachute jump. The afternoon's programme ended with a mass fly-past and stream landing by Sea Hawks, sixteen of which were on the runway together after touch-down.

The Norton Sword being presented to Tech. Cdt. Griffith by Air Chief Marshal Sir John Baker at the Henlow passing-out parade referred to on this page.

Sea Furies in Denmark

THE Southern Air Division, R.N.V.R., under the command of Cdr. G. M. Rutherford, M.B.E., D.S.C., R.N.V.R., paid a visit to the Danish Air Force base at Vaerlose, near Copenhagen, during the week-end before last. They flew their Sea Furies from their base at Benson to Vaerlose *via* Falkenburg, Holland; and during the second leg they carried out exercises with a Danish naval vessel.

Six years ago the Division, then based at Culham, visited Gardamoen, in Norway. The latest flight is the first visit by reserve forces to Denmark.

Inspector of Mountain Rescue

FOR the first time since the original mountain rescue unit was formed in Anglesey during the war, a full-time Inspector of Mountain Rescue has been appointed. He is S/L. A. R. Gordon-Cumming, a fighter pilot, R.A.F. mountaineer and one-time member of the Air Ministry Selection Board. There are eight R.A.F. Mountain Rescue Units in Great Britain and one in Cyprus, the latter unit having been formed during the last year. The teams, made up of volunteers, give assistance not only to crews of crashed aircraft but also to civilians.

During 1954 the home teams saved the lives of 33 people and recovered the bodies of several others. S/L. Gordon-Cumming was educated at Eton, joined the R.A.F. in 1943 and served as an instructor in South Africa and England before joining No. 73 (Fighter) Squadron in Malta. He will supervise the training and work of all Mountain Rescue Units and organize desert and jungle rescue teams overseas.

R.A.A.F. Antarctic Beaver

THE R.A.A.F. Flight of the Australian Antarctic Division recently took over the Beaver which was bought by the Australian Government for them and assembled by de Havillands at Bankstown, N.S.W. The handing-over ceremony, performed by the Rt. Hon. R. G. Casey, Minister for External Affairs, and Air Marshal Sir John McCauley, Chief of the Australian Air Staff, took place at the Government factory at Fishermens Bend.

The Beaver was then demonstrated by the leader of the Antarctic Flight, F/L. D. Leckie—who was awarded the A.F.C. for his part in the 1954 Antarctic Expedition—and flown to Laverton.

Valiant Accident

THE crew of a Valiant lost their lives when the aircraft crashed shortly after taking off from R.A.F. Station Wittering on July 29th. They were S/L. E. R. Chalk, the captain; F/L. A. G. Allen, second pilot and engineer; F/O. T. S. Corkin, navigator; and F/O. A. R. Lyons, signaller.

R.A.F. Appointments

THREE important appointments recently announced by the Air Ministry are those of A.V-M. D. Jackman, C.B., C.B.E., to be Director-General of Equipment; A. Cdre. M. L. Heath, O.B.E., to be Director-General of Personnel (II), with the acting rank of air vice-marshal; and A. Cdre. G. L. Worthington, C.B.E., to be A.O.C. No. 40 Group, Maintenance Command, also with the acting rank of air vice-marshal.

A Sultan Visits Upwood

ON Thursday of last week, His Highness Said bin Taimur, Sultan of Muscat and Oman, accompanied by Sir Bernard Burrows, British Political Resident in the Persian Gulf, visited R.A.F. Station Upwood, Hunts. A royal guard of honour was mounted and the Queen's Colour was paraded. The Sultan inspected members of the Liverpool University Air

No. 810 Sqn., at Lossiemouth, recently commissioned, is equipped with the latest variant of the Sea Hawk, the F.G.A. (Fighter / Ground Attack) Mk 4. Shown here with the squadron flash and badge on their noses, these aircraft have powered ailerons which significantly improve their Mach and low-level performance.

SERVICE AVIATION . . .

Squadron in camp at the station and watched a flying display by Hunters, Canberras and Lincolns.

Attaché at Teheran

THE first air attaché to be appointed to Iran since the Abadan crisis in 1952, G/C. J. E. Pelly-Fry, D.S.O., is this month taking up his appointment at Teheran.

G/C. Pelly-Fry, who has recently held a staff appointment at SHAPE, will be particularly remembered for his leadership, in December 1942, of the daylight attack on the Phillips works at Eindhoven in Holland.

No. 70 Squadron Standard

AT R.A.F. Fayid on July 16th, A.V-M. Sir Hazelton R. Nicholl, K.B.E., C.B., Retd., presented a squadron Standard to No. 70 Sqn. Sir Hazelton commanded the squadron from 1926 to 1928. Air Chief Marshal Sir Ronald Ivelaw Chapman, a former member of the Squadron, and Air Marshal Sir Claude Pelly, C.-in-C., M.E.A.F., were among those present at the ceremony.

Under the command of S/L. T. N. Staples, D.F.M., the squadron is now equipped with Valettas and is flying troops and equipment out of the Canal Zone.

Cruises for Visiting Cadets

VISITING air cadets from Canada and the U.S.A are to be taken for 53-mile cruises on the Thames between Woolwich and Windsor next week-end. The journeys will be made in R.A.F. 41ft range-safety launches.

No. 36 Squadron History

TO help in writing a history of the unit, S/L. J. J. O'Meara, C.O. of No. 39 Squadron, asks past members to send him any relevant information, photographs or documents they may have; he promises that all negatives or other material will be carefully handled and promptly returned. Information concerning the period during which the unit served in India is particularly sought after. The address is: Officer Commanding, No. 39 Squadron, R.A.F. Luqa, Malta, B.F.P.O. 51.

Henlow Passing-out

TWO entries at the R.A.F. Technical College, Henlow, passed out together at a parade on July 22nd. They were Nos. 1 and 3, the first of which had completed three years' university training, and the second of which was about to leave for universities. The reviewing officer was Air Chief Marshal Sir John W. Baker, Controller of Aircraft, Ministry of Supply. With him on the reviewing dais were Air Marshal Sir Victor Groom, A.O.C.-in-C. Technical Training Command, and A. Cdre. C. L. Dann, Commandant of the College.

The Sword of Honour for the best cadet in No. 1 Entry was presented to Sen. U/Off. B. Harris (a photograph of the presentation appeared on p. 175 last week), and the Norton Sword for the best cadet in No. 3 Entry to Tech. Cdt. J. B. Griffith.

R.O.C. Long-service Awards

THIRTY members of the Royal Observer Corps have been awarded medals for 12 or more years' service with the Corps.

Three-Standard Wing

FOR the first time in the history of the R.A.F. the three squadrons of a wing based at the same station all have Standards. They are Nos. 14, 20 and 26 Sqns. (the last named received its Standard on July 12th), based at Oldenburg. On the date of the final presentation all three Standards were paraded together.

B.F.N.'s Tenth Birthday

THE British Forces Network radio station in Cologne, run jointly by R.A.F., Army and ex-service personnel, recently celebrated its tenth birthday. It serves British forces in Germany and has, in addition, an audience of some five million Germans. Claiming to be one of the most modern of its size in Europe, the station will start V.H.F. transmissions this year.

Nos. 112 and 96 Squadron Ties

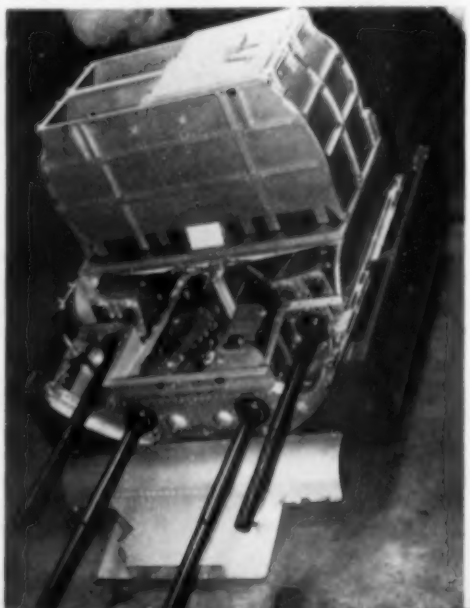
A SILK tie, bearing the crest of No. 112 Sqn., is now available, price 15s nett, on application to the squadron at R.A.F., Brüggen, B.A.O.R. 1, Germany.

The No. 96 Sqn. tie is also available, price 16s 6d, on application to the squadron at R.A.F. Ahlhorn, B.A.O.R., 25, Germany.

Reunion

THE ninth annual reunion for all members of No. 219 Sqn. and Nos. 6219 and 6029 Servicing Echelons will be held at the Clarendon Restaurant, Hammersmith, London, on September 24th. Tickets, price £1 5s, from S/L. Farrar, R.A.F. Staff College, Bracknell, Berks.

The picture below, sent in by a reader in Australia, shows one of three B-29s of the U.S. 313th Air Division which recently made a goodwill visit from Okinawa to Mascot airfield in Australia. The "Flight" photograph (right) illustrates the Hunter gun pack which was shown for the first time with barrels in place during the visit of the Libyan defence minister to Odiham on July 19th.



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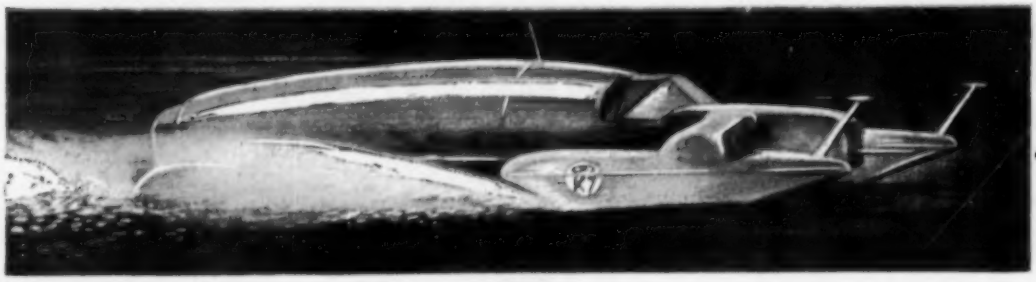

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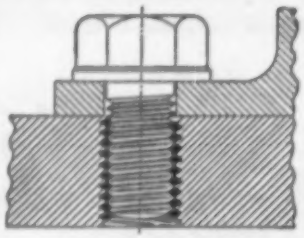

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STARTING salary according to age, up to £402 (men) or £362 (women) at age 25 or over.

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APPLICATION Forms from Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 143-144/55, to be returned by August 18th, 1955. [4061

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM British Overseas Airways Corporation, of Airways House, Great West Road, Brentford, Middx:

APPLICATION No. 553 for the following amendments to the Normal Scheduled Services which they operate between London and Sydney, Tokyo, Hong Kong and Singapore on the routes set out as Routes Nos. 1, 2, 3, 4 and 5 in Schedule "A", Part I, of the Terms of Reference issued to the A.T.A.C. by the Minister of Civil Aviation on 30th July, 1952:
(a) The inclusion of an optional traffic stop at Athens on the services operated on Routes 1-5 inclusive, and (b) Inclusive of optional traffic stop at Delhi, Rangoon and Bangkok on the service operated on Route 1.

APPLICATION No. 554 for a Normal Scheduled Service with Boeing Stratocruiser aircraft for the carriage of passengers, supplementary freight and mail between London Airport and Trinidad with intermediate traffic stops at Montreal, Bermuda and Barbados, at an initial frequency of one service weekly, increasing according to traffic demand, during the period from 3rd November, 1955, to 2nd November, 1956.

APPLICATION No. 140/1 from Transair, Ltd., of Croydon Airport, Croydon, Surrey, for an amendment to the terms of approval of the Inclusive Tour Service which the Company are approved to operate with Dakota aircraft in conjunction with Pilgrim Tours between London (Croydon/Gatwick) and Tarbes (for Lourdes), at a frequency of from two to four return flights weekly, during the season April to October inclusive each year for the period up to 30th October, 1958, so as to include a traffic stop at Cardiff on one service each week, commencing 1st April, 1956.

FROM Aquila Airways, Ltd., of 1, Great Cumberland Place, London, W.1:

APPLICATION No. 151/2 for continued approval for a period of seven years, commencing 1st January, 1956, of the Normal Scheduled Service which they operate with Hythe and/or Solent Flying Boats, for the carriage of passengers, supplementary freight and mail between Southampton Water and Lisbon, Madeira and Las Palmas, without traffic rights between Southampton and Lisbon, at a frequency of up to two services weekly.

APPLICATION No. 211/1 for an amendment to the terms of approval of the Seasonal Normal Scheduled Service which the Company are approved to operate with Hythe, Solent and Sandringham Flying Boats between Southampton Water and Capri, via Marseilles, at a frequency of from one to three return flights weekly during the season April to September inclusive each year, for the period up to 30th September, 1960, so as to include Ischia as a terminal or intermediate traffic stop.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [4068

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(c) **INTERMEDIATE AND SENIOR TECHNICAL ENGINEERS** in the Structures Analysis, Stress and Aeroelasticity Sections of the Aircraft Technical Office.

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(d) **INTERMEDIATE AND SENIOR TECHNICIANS** in the Performance, Aerodynamics and Wind Tunnel Sections of the Aerodynamics Department.

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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AN engineer is required who has design and practical experience of aircraft electrical installations and wiring.

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THERE is a vacancy for this position in the London office of a firm engaged on priority work on a Government contract.

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STRUCTURAL TEST ENGINEERS

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A VACANCY exists for an Assistant Engineer in the mechanical engineering laboratory dealing with radar scanners and similar mechanisms. Applicants should have had technical training to Higher National Certificate or Degree standard, and knowledge of aircraft stressing methods would be an advantage. [4025

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REF. SPO/80: Assistant Development Engineer: To assist in development work in connection with propeller turbine power plants. Qualifications: O.N.C. or equivalent; at least 5 years' experience in operation and maintenance of high-power aero engines; flight and engine test experience desirable. Salary scale £742 10s.—£867 10s. per annum.

REF. SPO/79: Technical Assistant: To assist in recording and analysis of data in connection with piston and gas turbine engine operation. Qualifications: recognised training and experience as an aeronautical engineer; ability to compile accurate and analytical reports; O.N.C. desirable. Salary scale £742 10s.—£867 10s. per annum.

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Q.F.I./STAFF PILOT with Meteor experience required. Single accommodation available. Apply: Chief Pilot, Airwork Limited, R.N.A.S., St. David's, Pembrokeshire. [4057

TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147

ACCOUNTS Clerk experienced in costing required. Experience in aircraft industry an advantage. Excellent opportunity. Progressive position. Salary according to age and experience. Apply Edgar Percival Aircraft, Ltd., Near Abridge, Essex. [4034

JIG and Tool Draughtsmen required. Interesting projects. Airframe experience desirable. Apply Edgar Percival Aircraft, Ltd., Stapleford Tawney Aerodrome, near Abridge, Essex. Tel. Theydon Bois 2321. [4042

SENIOR Stressmen required. Complete aircraft design, interesting projects. Assistance with housing to approved applicants. Apply Edgar Percival Aircraft, Ltd., Stapleford Tawney Aerodrome, near Abridge, Essex. [4043

FIRST-CLASS Estimator of small machine details required by King Aircraft Corporation, Hillington, Glasgow, S.W.2. Apply in writing to Works Manager stating age, experience and salary required. [4047

CHIEF designer required by company manufacturing electronic and mechanical measuring instruments for industrial and aircraft use. Salary £1,000-£1,200, housing assistance, pension scheme. Full particulars to Box 5488. [4065

ARMSTRONG SIDDELEY MOTORS LIMITED, invite applications for a senior executive position on gas turbine aero engine Technical Sales. Good knowledge of performance, work and managing ability essential. Please quote reference WTWB, Armstrong Siddeley Motors, Ltd., Coventry. [4033

RAMSGATE Airport requires immediately a commercial pilot, instrument rating and instructor's endorsement preferable, to fly club and charter aircraft, Rapide, Messenger, Auster, etc. Reply Air Cruise, Ltd., Lydd Airport, Kent. Tel.: Lydd 315. [4054

WORKS Manager for new substantial company in London area manufacturing complete aircraft. Must be top grade man with wide experience and background. Excellent opportunity in progressive organisation. Reply in confidence, full details of experience, Box 5403. [4044

DEVELOPMENT engineers and technicians required in research department of a well-known firm of precision engineers, particularly for work in connection with servo systems, small precision motors, and gyroscopic instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0146

DRAUGHTSMAN, senior, required for work on aircraft components. Experience in the aircraft industry desirable, but not essential; good mechanical engineering draughtsman will be considered. Capable of working with the minimum of supervision. Write giving details of age, experience and technical qualifications to: King Aircraft Corporation, Fifth Street, Montrose Ave., Hillington, Glasgow, S.W.2. [4058

CHIEF ASSISTANT DESIGNER required by long established aircraft company opening a design department in the West End of London. He would be responsible for a new design team engaged on a project of considerable national importance. Experience of hydraulic and electrical systems, engine installation and fuel systems are of more importance than experience of structural problems, although a broad background of aircraft design would be preferable. Knowledge of hydraulic flying controls and servo design and theory would be an advantage although not essential. Age 35/45 years. Salary £1,500 to £2,000 per annum, with pension. Write in confidence, setting out full details of past experience and qualifications to Box AC 09789, Samson Clark & Co., Ltd., 57-61 Mortimer Street, W.1. [4021

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OPPORTUNITY for Ex-R.A.F. pilot for Club instructional work, N.W. area. Previous instructional flying experience advantage. Box 5495. [4067

DAN-AIR SERVICES, LIMITED, require Operations/Commercial Assistant at London Office. Age 23-33. Knowledge of traffic handling and air operations essential. Must have good business ability. Apply in writing to General Manager, Dan-Air Services, Ltd., 36-38, New Broad Street, London, E.C.2. [4003

WANTED, DRAUGHTSMEN to design in aluminium for sales development. Must possess Higher National Certificate in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to Northern Aluminium Co., Ltd., Bush House, Aldwych, London, W.C.2. [0348

SENIOR and Intermediate Design Draughtsmen with aircraft and mechanical engineering experience required. The work will interest men who can apply their design ability to the development of new equipment which has a steadily growing application. Pleasant working conditions. Pension and Insurance Schemes. Housing assistance for successful applicants. Within easy reach of Bournemouth. Special transport facilities. Apply in writing to Personnel Manager, Flight Refuelling Limited, Tarrant Rushton Airfield, Nr. Blandford, Dorset. [4028

ELECTRONIC Engineer. An experienced engineer is required for the research and design of circuits with application to a Guided Missile System. He should have at least two years' experience and preferably be of degree standard, although applicants with H.N.C. or C. & G. will be considered. The work is of great interest and importance, offering responsibility and good opportunities for promotion. Write in detail, quoting Ref. 68, to: Personnel Manager (Technical Employment), de Havilland Propellers, Limited, Hatfield, Herts. [4041

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